SETTING THE STANDARDS 15 YEARS

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BYTE

SEPTEMBER 1990

A McGRAW-HILL PUBLICATION

63 of the World's Most Influential People in Personal Computing Predict the Future, Analyze the Present

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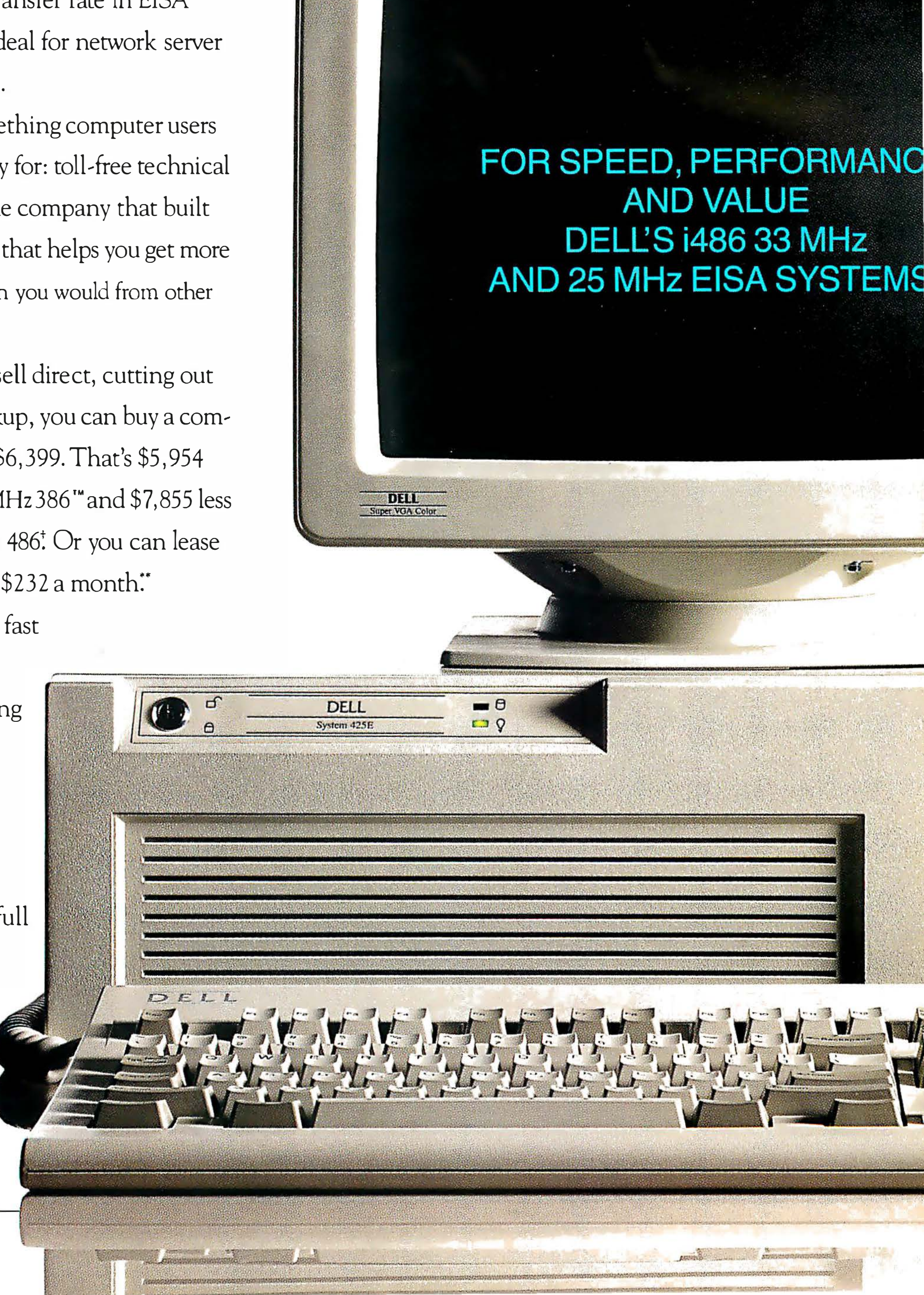
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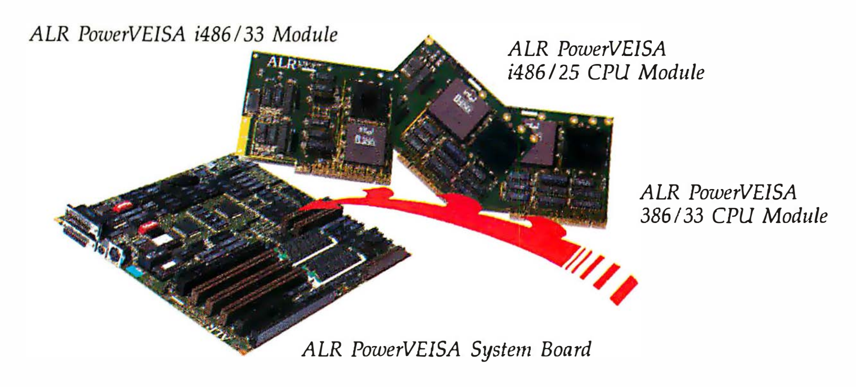
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The modular design of this system lets you change processors in about five minutes. More importantly, you can change the CPU module without having to replace cache or system memory, saving you hundreds of dollars when compared to some compet-itive upgrade schemes.

Engineered for the future, the floor-standing chassis of the PowerVEISA 386/33 can accommodate a total of 49-MB of memory and up to 1.2-GB (gigabytes) of fixed disk storage. Its EISA capabilities let you take advantage of the latest in 32-bit I/O and bus mastering technology, while remaining compatible with 8 and 16-bit "AT®" boards.

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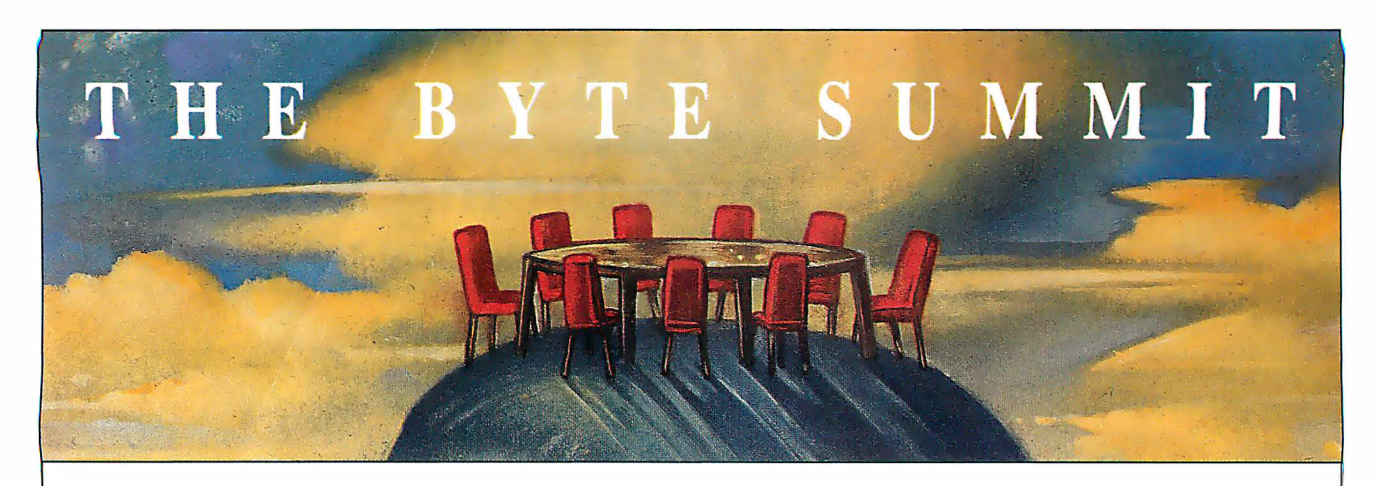
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From BYTEnet: Call (617) 861-9764
On disk: See card after **184**

EXPERT ADVICE

BYTE (ISSN 0360-5280/90) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America. **Postmaster:** Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520.



***The BYTE 15th Anniversary team:** (from left to right) Jeff Edmonds, copy editor; Amanda Waterfield, editorial assistant; Jane Morrill Tazelaar (seated), senior editor; Jan Muller, art assistant/photo researcher; Bob Ryan, technical editor; and Nancy Rice, art director. Not shown are Joe Gallagher, assistant art director; Lisa Nardecchia, Summit designer; Gene Smarte, special projects editor; and Andy Reinhardt, associate news editor.*

THE ONCE AND FUTURE GURUS

See what 63 gurus think about the future, then stroll down memory lane

If you could talk to any of the computer industry gurus, whom would you pick? What questions would you ask? This was the delightful dilemma faced by the BYTE crew responsible for our 15th Anniversary BYTE Summit. Led by Jane Morrill Tazelaar, senior editor, staff members from every editorial department conducted and compiled interviews with 63 of the most important movers and shakers in the business. The cumulative result is a unique and comprehensive view of the future of computing.

Enthusiasm for the project ran high. For those doing the interviews, hearing what these luminaries had to say about the industry was a thrill. As Tazelaar put it, "It really blows your mind to answer your phone and find Jack Kilby on the other end."

After completing the interviews, some staff members volunteered to transcribe them from cassette to an ASCII file. The transcribed files totaled over half a megabyte—enough to fill 500 pages in BYTE. Many extra hours were spent editing and collating questions to boil that down to the 70-plus pages in this issue. We hope you find the BYTE Summit entertaining, thought-provoking, and revealing.

But How Did We Get Here?

To get a true perspective on the future, it pays to review the past. The second part of our Anniversary section, "15 Years of Bits, Bytes, and Other Great Moments," is a time line compiled by Gene Smarte, special projects editor, and Andy Reinhardt, associate news editor. It follows industry milestones from 1975, the first year BYTE was published, to 1990.

And we have one last historical treat for you. In researching the article "The Creation of the IBM PC," Janet Barron, technical editor, "discovered" the original prototype IBM PC. While she was speaking with one of the PC's designers, David J. Bradley, Barron asked if IBM had a photo of the original PC. Bradley replied that a colleague had the prototype in his office closet and volunteered to send it to her.

The photo of the first IBM PC motherboard (on page 416) is the only one ever to have appeared in any computer magazine. That it is published in BYTE's 15th Anniversary issue seems only fitting. ■

—Michael Nadeau

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Shifting the Balance Of Power in Database Management

There's a new leader in the relational database management world. Its name is FoxPro.

FoxPro is the first and *only* microcomputer database management system that combines astonishing performance with a sleek interface of amazing power and beauty.

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- FoxPro is so easy to learn and use, even beginners can become productive immediately; yet it's powerful and sophisticated enough to satisfy the needs of the most demanding developers and power-users.
- FoxPro gives you choices instead of limits: use a mouse or a keyboard; type commands or use the object-oriented interface; run in one window, or hundreds.
- FoxPro is so efficient, it runs in a 512K PC-XT, yet it's able to take advantage of the speed, expanded memory and extended video modes of the most advanced machines available. You don't even need a graphics card or special windowing software.



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Fox Software products are famous for their unmatched execution speed. FoxPro extends that tradition.

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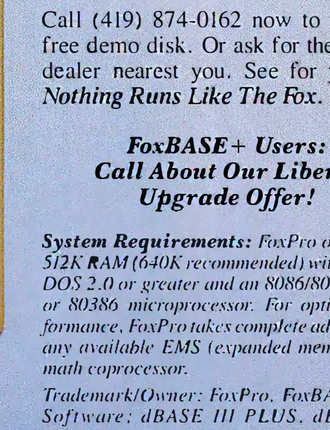
We've been producing superb database management software since 1983. And our products for both the PC and the Macintosh continue to win awards worldwide.

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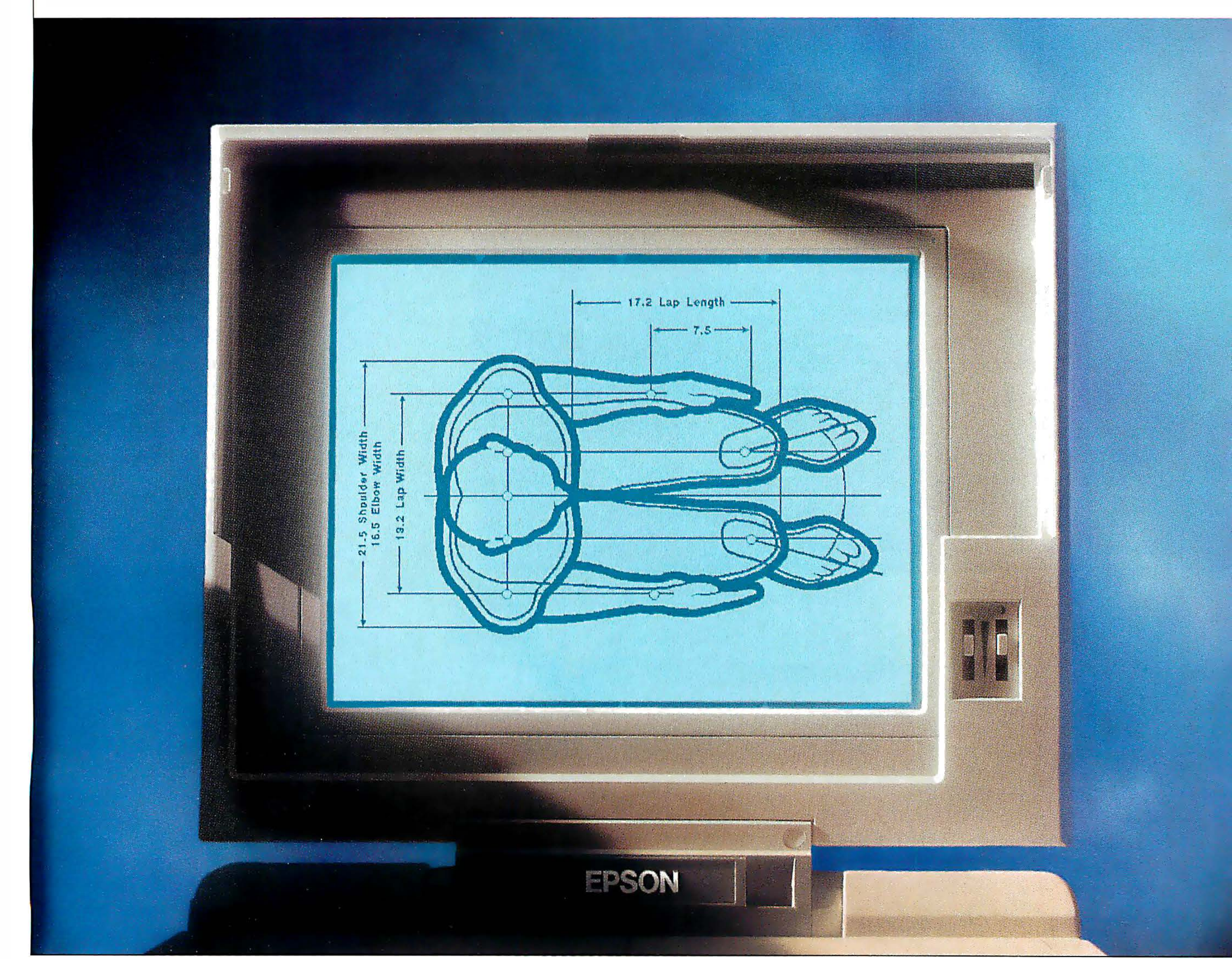
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Introducing the Equity LT 386SX Laptop

Adding power, speed and peripherals to a personal computer is a constant test of design innovation.

Configuring a *laptop* to meet expanding needs becomes an even more demanding challenge because size, weight, and battery life come dramatically into play.

Epson® engineers have met that challenge with their new Equity LT 386SX, featuring one of the most powerful microprocessors available in a battery-powered laptop. It is a design of both distinctiveness and common sense.

Epson's unique, removable hard drive: key component of the most flexible laptop ever made.

Epson's Datasafe hard drive can be removed, making it easy to transport, or store separately for added security. With an optional* drive port, the hard drive can plug directly into a desktop computer. It offers a choice of 20 MB or 40 MB capacity, and a shock indicator that alerts the user to the occasional hard knock.

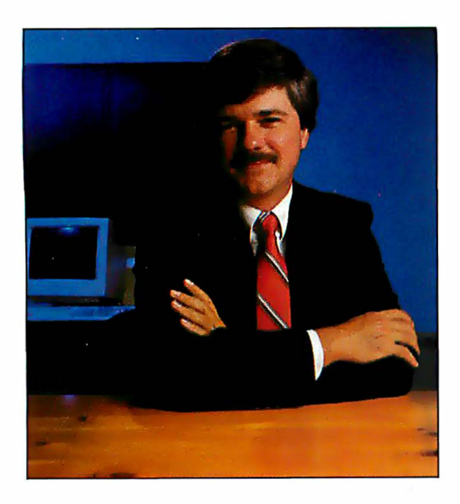
The modular design of Epson's entire laptop series suggests a new standard for customized performance. The user can easily install or remove options such as a modem, extended RAM, external keyboard, or 2/3 length industry standard card. The VGA screen can also be removed or left in place when using an external monitor.

The Epson laptop indicates its own vital signs—battery life, speed, and disk drive in use—on a unique LCD status bar, and even has the good sense to turn off its own screen and hard drive when not in use.

The LT 386SX offers a degree of speed, power and flexibility once limited to desktop computers. In fact, there is one feature of this remarkably engineered bit of technology that a desktop can only envy. Its size.

Engineered For The Way You Work.





HAPPY ANNIVERSARY!

To celebrate 15 years of publication, we've thrown you a party

Senior Editor Ken Sheldon was standing in my door, a box in his hands. "Would you like to see the original, hand-assembled prototype of the first IBM PC motherboard?" he asked. "I have it here."

I knew that Ken was working on an article on the first PC as one of many special articles for this anniversary issue—but the actual original prototype IBM PC motherboard? Holy smokes!

Naturally, I said yes, and Ken then carefully unwrapped his prize. There it was: sire of all the PC progeny. Undoubtedly, this mass of hand-wiring and temporary sockets was among the most significant technological artifacts of our time. I felt as if I should be wearing gloves to handle it.

This was IBM's own original PC prototype—one of only two built. The other had been shipped to Microsoft in 1980 for development of the original PC software. What a treasure!

You can see and read more about "The Creation of the IBM PC" on page 414 in this issue. But don't stop there, because that's just a sample of the gems that you'll find in this Special 15th Anniversary Issue.

For example, in addition to a full, normal complement of features, reviews, First Impressions, news, and columns, we also have the "BYTE Summit," beginning on page 226. In it, 63 world leaders of the microcomputing industry—drawn from both the business and technological communities—address the 13 most important questions that will shape the industry for years to come. The "BYTE Summit" amounts to a sneak preview of the future, provided by those who will build that future.

Why are we doing all this? Why pack so much into one issue?

In a phrase, to say "Thank you."

With this issue, BYTE completes its 15th year of publication—the only general-circulation computer magazine ever to reach this milestone. You and a half million other readers around the globe have made it possible, and we wanted to pull out all the stops to give you a truly memorable issue.

And what a 15 years it's been. BYTE was born along with the microcomputer industry, back when the idea of a computer of your own was still a novel concept. In fact, small computers weren't even called "personal computers" until BYTE coined the term, in our May 1976 issue.

That's not the only common computer term that was born in BYTE. The *Oxford English Dictionary*, called the "final arbiter of the origins and use" of the English language, cites BYTE as the source for such computer terms as backslash, boot, bulletin (as in bulletin board), CD-ROM, clone, hacker, lap (as in laptop), transportable, user, WYSIWYG (what you see is what you get), and half a dozen other terms.



BYTE not only was there at the start, but it helped define the whole genre as it grew and matured from a hobbyist pastime to a cornerstone of modern business.

As the computer industry changed, our readers' needs changed, and so did BYTE. For example, as off-the-shelf products proliferated, BYTE published the industry's first microcomputer reviews and the first comparative reviews. BYTE also created the first magazine-sponsored computer lab and provided the first widely used microcomputer benchmarks.

Today, thanks to you, BYTE has reached record-high circulation levels and—because of your growing needs—is turning out more information than ever before, as you can see from the size of the issue you're holding.

That information falls into two broad categories: buying and using today's hardware and software, and understanding the emerging technologies that will become the tools of tomorrow. As always, BYTE is platform-independent, covering all major architectures and all significant operating systems.

About a year ago, as BYTE entered its 15th year, I added up the text file of what we had published to that point and found that it topped some 150 megabytes—well over a billion bits. Now, as we're well on the way toward the second billion bits, we're deeply honored that you've chosen to read BYTE, and we pledge to continue to do our best to meet your high standards.

Happy anniversary!

—Fred Langa
Editor in Chief
(BIX name "flanga")

New Turbo Debugger® & Tools

See through your code

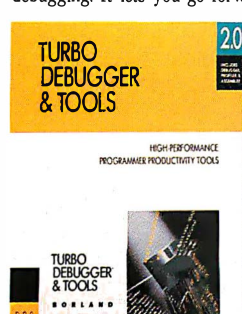
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Turbo Debugger® 2.0 has again advanced the art of debugging. It lets you go forward and also backward through your code with a brand-new technique called *reverse execution.* With it, you step backward—undoing program execution—to locate bugs previously passed over. And with our Turbo Drive™ technology, you can debug the largest programs using 286 protected mode or 386 virtual mode. Turbo Debugger also supports object-oriented debugging in Turbo C++ and Turbo Pascal.®



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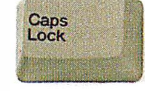
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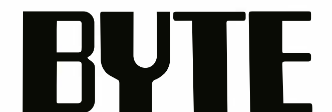
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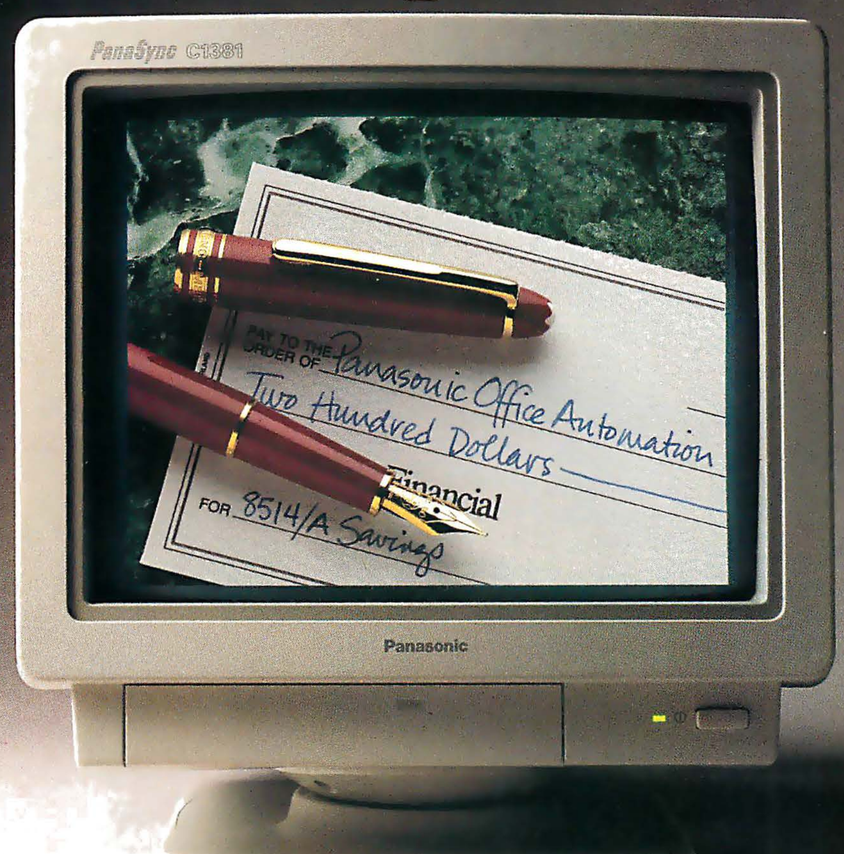
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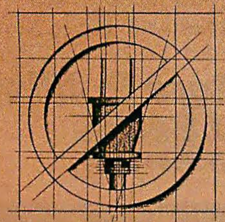
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Tuesday, May 1, 1990
8:00 AM
9:00 Meet with Cole and Laura
10:00 Finish proposal
11:00
12:00 PM Lunch with Penny and Rex
1:00
2:00 Staff Meeting
3:00
4:00
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Glenn and I reviewed the South contract last week.
great--we're both excited to be involved with the deal and
the start of a long-term business relationship. Following
we had questions about. If you want to discuss these
meeting next Thursday, just give me a call.
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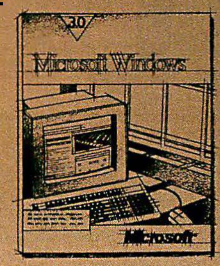
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MICROBYTES

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The Lotus Case: Judge Rules User Interface Is Protected by Copyright

> *"I conclude that a menu command structure is capable of being expressed in many if not an unlimited number of ways, and that the command structure of 1-2-3 is an original and nonobvious way of expressing a command structure.*
> *"The user interface of 1-2-3 is its most unique element, and is the aspect that has made 1-2-3 so popular. That defendants went to such trouble to copy that element is a testament to its substantiality.*
> *"I must disregard defendants' experts' predictions of doom for the computer programming industry if copyright is extended to the user interface and other nonliteral elements of computer programs. . . . Rather, this legal issue must be resolved in such a way as to extend copyright protection, clearly and unequivocally, to those nonliteral elements of computer programs that embody original expression."*
> **—Judge Robert Keeton**

When U.S. District Court Judge Robert Keeton issued his final declaration in the look-and-feel lawsuit filed by Lotus Development against Paperback Software, he wrapped up at least the first phase of one of the most closely watched legal cases ever to hit the computer industry. Judge Keeton's decision was firm and unambiguous, and if it sticks, it could deal a deathblow to software cloning, even in the form of a "compatibility" option such as that offered in Borland's Quattro Pro.

Although Keeton's ruling would not provide precedence for similar court cases being heard elsewhere in the country (e.g., Apple's suit against Microsoft over Windows), it's a significant decision in the legal wrangling over the protection of noncode aspects of software. Keeton tossed aside the nebulous concept of look and feel in favor of the more prosaic principle of "structure, sequence, and organization" to find that 1-2-3's user interface is a creative "expression" worthy of copyright protection. If the logic holds firm through subsequent court challenges—some observers predict it won't—it could become more difficult for software engineers to create products that don't infringe.

Among the giant look-and-feel cases twisting their way through the courts, the suit filed in 1987 by Lotus against two companies that make 1-2-3 work-alikes, Paperback Software (VP-Planner) and Mosaic Software (Twin), might have been the cleanest. The battle between Apple and Microsoft/Hewlett-Packard over Windows is complicated by messy contractual and licensing issues, while the suit filed by Ashton-Tate against dBASE cloner Fox Software involves tricky questions about the copyrightability of computer languages and of products derived from publicly funded research. At its most basic, the Lotus case promised to answer the question of how much copying is too much.

As in any copyright case, the judge had to first determine whether 1-2-3 was indeed copyrightable and then whether the defendants' products violated that copyright. There is virtually no legal dispute over the right to protect underlying source and object code, and in any event there was no evidence here that Paperback Software had copied 1-2-3 code. The problem was whether by imitating 1-2-3's menus and commands the defendants had acted unlawfully.

In making his determination, the judge said that he had not found the concept of look and feel, as expressed in earlier lawsuits outside the software industry, to be helpful; rather, he relied on Lotus's definition of a user interface, as determined by the structure and organization of menus, the macro language, the use of function keys, and so on.

Keeton quickly pointed out that Lotus doesn't own the concept of an electronic spreadsheet. He also found certain elements of 1-2-3's user interface to be nonprotectable; for example, he said that the use of a rows-and-columns screen arrangement with horizontal and vertical cell addresses was not copyrightable because Lotus didn't invent it and it was essentially the only way to organize a spreadsheet.

If the realization of an electronic spreadsheet involved no creativity beyond what was dictated by the concept itself, 1-2-3's user interface would not be copyrightable. But Keeton found the organization and wording of the program's descending menu tree to constitute the essence of its commercial and intellectual value. According to Esther Schachter, editor of *Computer Law and Tax Report*, Keeton looked at the "gestalt" of 1-2-3, rather than at specific words or screens, to determine that it is indeed an original work. The judge also said that even though commands such as Print or File Retrieve are functional in nature, that doesn't preclude awarding protection to the overall menu scheme.

The most important point in support of 1-2-3's nonunique originality came from alternative products on the market. Paperback Software argued that 1-2-3 was a market standard and that achieving success required making a program "compatible" with the standard's keystrokes, macros, and file format. But Keeton saw the success of programs such as Microsoft Excel and Computer Associates' SuperCalc4 as evidence that other, incompatible spreadsheet designs were technically feasible and commercially viable.

After finding that 1-2-3's structure was original, the judge had to determine whether that structure represented a "substantial" part of its expressiveness.

continued

NANOBYTES

One plaintiff happy with U.S. District Court Judge Robert Keeton's ruling in the Lotus/Paperback Software case is **Ashton-Tate** (Irvine, CA), which sued Fox Software and The Santa Cruz Operation way back in 1988 for allegedly violating the look and feel of its dBASE products, a suit that Fox said has "absolutely no merit." "We think the judge should be given a Nobel prize," Stan Witkow, vice president and general counsel for Ashton-Tate, told BYTEWEEK.

Weighing in with a different opinion was the **League for Programming Freedom**, which planned to protest the Lotus lawsuits with its second march to the company's headquarters in Cambridge, MA. "The Lotus victory sets a precedent that threatens to bollix the entire software industry. . . . Imagine if there were a copyright on the layout of keys on the typewriter," the league said in its official statement. "We are marching to call public attention to the new monopoly that is being rammed through the courts." Besides cofounder **Richard Stallman** (MacArthur Fellowship winner and father of the Free Software Foundation), the league's membership includes AI pioneer Marvin Minsky and Lisp inventor John McCarthy.

The **National Science Foundation** is working with industry and academia to develop **an advanced computer network** expected to transmit 1 billion bits of data per second. More than $100 million for the project has come from corporations, including IBM, AT&T, MCI, and the regional Bell telephone companies. Among the universities involved are MIT, the California Institute of Technology, the University of Pennsylvania, and the University of California at Berkeley. Government laboratories in the project include Lawrence Livermore (California), Los Alamos (New Mexico), and the five supercomputing centers. NSF official Stephen Wolff said he is confident that "new sorts of wonderment will ensue" from the project. Weather forecasting, three-dimensional medical imaging, and multimedia teleconferencing are some of the applications planned for the network.

"That the answer to this question is 'yes' is incontrovertible," he wrote. "The user interface of 1-2-3 is its most unique element."

Chilling?

The value of Keeton's decision as legal precedent will remain unknown until future cases have passed through the courts. Paperback Software has vowed to appeal. The resolution of this knotty problem might end up in the U.S. Supreme Court if Congress doesn't act first to provide legislative clarification.

Some analysts said that the Keeton decision greatly expands the definition of copyright protection for software. The judge apparently found the copyright violation so obvious and egregious that he was able to pronounce in fairly sweeping terms that the structure and organization of 1-2-3 represent its primary value. A more subtle case of copying might have required a finer definition of structure.

But Keeton also complained in his decision about the lack of solid precedents and said that he opted for a strict reading of congressional statutes. In that sense, the decision is quite narrow: He refused to consider the defendants' wish that he forge new copyright law by drawing a "bright line" to limit software copyrighting to the underlying code. To do so would exceed his jurisdiction, Keeton said.

Keeton also declined to consider—although he did take testimony on the subject over Lotus's objections—philosophical questions about the "chilling effect" of a finding for Lotus. He wrote that numerous experts, including VisiCalc coauthor Dan Bricklin, testified against extending copyright protection beyond underlying code. But he concluded that the views of these experts contradict the evident intentions of Congress in its 1976 and 1980 copyright statutes.

Tom Lemberg, chief counsel for Lotus, not surprisingly argues that protecting the user interface actually helps software innovation. "We see it as a great victory for innovation because it provides a framework that allows people to invest in engineering and be protected enough to recover their investments," Lemberg said. "If the law protected the right of a programmer to copy the de facto standard, then there would be no need to innovate."

"99% Different" Doesn't Count

A few key elements of Keeton's decision could spell trouble for Borland, subject of Lotus's latest legal action, and other companies that incorporate what can be construed as 1-2-3-like menus. The judge quoted from earlier decisions that "the piracy of even a quantitatively small fragment . . . may be qualitatively substantial," and "a laundry list of specific differences . . . will not preclude a finding of infringement where the works are substantially similar in other respects."

"If one publishes a 1000-page book of which only a 10-page segment is an unauthorized reproduction of copyrighted material, and if the 10-page segment is a qualitatively substantial part of the copyrighted work, it is not a defense to a claim of infringement that the book is 99% different from the copyrighted material."

Other cases, particularly the suit between Apple and Microsoft, might have more to say about the problem of defining originality and copyright in a standards-based software environment. A finding as broad as Keeton's could cause nothing but confusion when independently developed applications use similar screens, menus, and file formats. And if we ever achieve the world of small, interchangeable program "objects" envisioned by Bill Gates and other software developers, we'll be in a real legal mess.

—*Andy Reinhardt*

Macintosh Veterans Conjuring New Magic

Two of the prime forces behind the Macintosh are heading up a new Apple spin-off to develop "personal intelligent communicator" products. Bill Atkinson, principal designer of MacPaint and HyperCard, and Andy Hertzfeld, author of most core Macintosh software, along with Marc Porat, ex-manager of business development at Apple's Advanced Technologies Group, will be the "executive team" heading General Magic, Inc.

Just what's going on with GMI has been a topic of quiet but rampant speculation, since the new company was green-lighted by Apple 90 days before it was publicly announced. Apple would say only that the "concern will address market segments outside of Apple's mainstream business."

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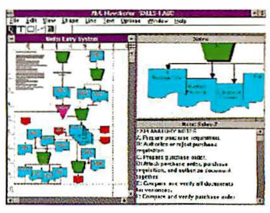
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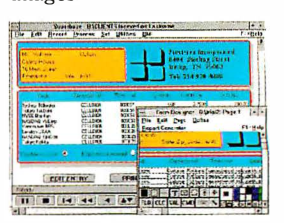
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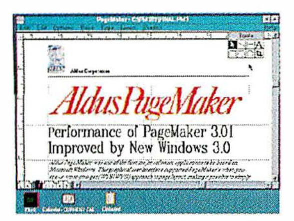
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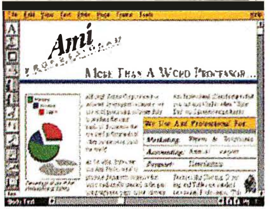
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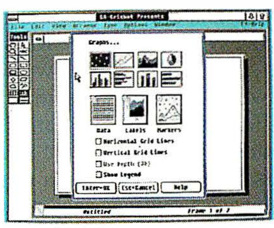
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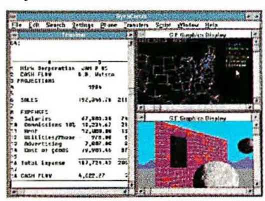
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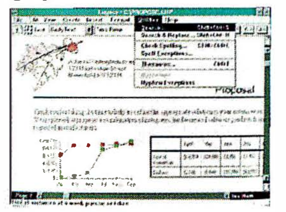
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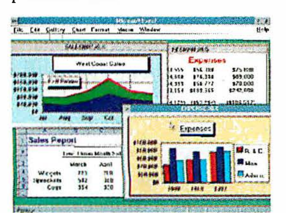
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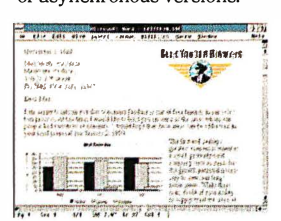
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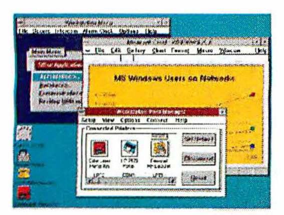
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NANOBYTES

PostScript laser printers are taking a dive in price. **QMS** (Mobile, AL), which has tended to set price trends in this field, zapped $1000 off its eight-page-per-minute models. The 68000-controlled PS 810 and 820 now sell for $3995 and $4995. QMS also knocked $500 off its 68020-based Turbo models, which now sell for $5995 and $6995. Meanwhile, **Océ Graphics** (Mountain View, CA) reduced the price of its color printer by $2000; the thermal printer now sells for $8990.

While lawn-conscious Americans were mowing their yards this summer, several top computer makers were **mowing their prices**. **Tandy** (Fort Worth, TX) did its usual hot-weather trimming, lowering the price of the 2800 HD laptop from $3499 to $2999 (and, until the end of this month, throwing in a free cellular phone) and cutting the 1000 TL/2 from $1299 to $999. As a "competitive pressure move," **Zenith Data Systems** (Mt. Prospect, IL) pruned $300 off its Z-386 SX desktop computer. The company shaved a similar amount off the price of the SupersPort 286e portable. And with new versions in the works, **NEC Technologies** (Wood Dale, IL) took the price-whacker to its UltraLite laptop, buzzing off as much as $1000. The 2-MB model is now $1999; the 1-MB model, $1599.

Novell (Provo, UT) plans to start shipping this fall a family of products for enabling NetWare 386 LANs to communicate with IBM mainframes. The software and associated architecture, collectively called NetWare 386 Communication Services, supports mainframe links over Token Ring networks and Synchronous Data Link Connection links. The family of connectivity packages will consist of NetWare 386 Services for SAA 1.0, which runs on the server, and NetWare 3270 LAN Workstation packages for Windows 3.0, DOS, and Macintosh systems plugged into the network. Software that will allow OS/2 or Unix workstations on a NetWare LAN to communicate with a mainframe will be released in 1991, said Gerry Machi, director of marketing for Novell communications products.

information from sources familiar with the project, GMI is working on a hand-held device for writing and sending electronic messages. Some Apple watchers say that the machine will use a pen and tablet and be capable of reading handwritten input.

HyperCard evolved from a minimalist Rolodex program that Bill Atkinson wrote in 1985; it used a card as an information container. A machine smaller than the Mac might require a smaller information container in a smaller working environment—say, a "postcard" instead of a "desktop." Those postcards need addresses if you want to send them anywhere, and Atkinson has already shown that he can make a hypertext-linked database out of cards, with a proprietary data-compression scheme that minimizes storage requirements of those cards. This compression scheme would be essential in such a system.

Andy Hertzfeld codes mostly in assembly, which allows him to write fast and tight programs. Such programs would be perfect for a hand-held machine.

Marc Porat's background includes setting up large-scale networks. It's likely that these postcards will be delivered by way of a special network; according to some sources, the GMI machine will operate with both radio waves (using Motorola's Ardis network, one source said) and telephone lines. Porat's latest stint at the Advanced Technologies Group has kept him up on the latest R&D, such as work going on in handwriting recognition.

The fact that Apple has a nonexclusive license to manufacture what GMI conjures up implies that there's another manufacturing concern involved in this, but quietly. Insiders say that Sony is involved; that company has had a long relationship with Apple, providing it with power supplies and disk drives. Sony recently introduced a product called the CPT-1 that has been, interestingly enough, impossible to find in stores around San Francisco. The CPT-1 has a pen attached to it that lets you use handwritten characters as input. If Sony were to provide pen hardware and screens for GMI, it could also supply the same hardware to other computer companies. GMI's communicator might very well use a pen instead of a keyboard. You can select an icon with a pen instead of a mouse.

If this machine is to be more useful than an automated FiloFax, it will have to print things out. If it has a thermal printer, why not use it as a fax machine as well? Observers also speculate that this device will have an internal modem that's fax-compatible.

In any case, the device that GMI will produce won't be immediately forthcoming. One Apple insider put it this way: "Think of what the Macintosh was envisioned as in 1981. That had changed drastically by 1982, and it didn't ship until 1984. They have a vision; now they need time to develop it."

—*Laurence H. Loeb*

Experimental Holographic System Promises Massive Data Storage, Rapid Access

After several years of research, Microelectronics and Computer Technology Corp. (Austin, TX) says that it has developed a working model of holographic data storage. The federally funded MCC says that within two years, it could have prototype storage systems with a capacity of up to a gigabyte, read access times of between 1 and 10 μs, and write times of approximately 100 μs. This would mean an average data transfer rate of between 100 and 800 MBps.

MCC says that a future commercial product derived from this technology could store 1.125 terabytes and be capable of read times as low as 100 ns and write times of 10 μs; the data transfer rate could be as fast as a phenomenal 50 gigabytes per second, MCC officials say. The eventual cost of such a data storage device would be about the same per bit as magnetic drives and optical disks, says MCC.

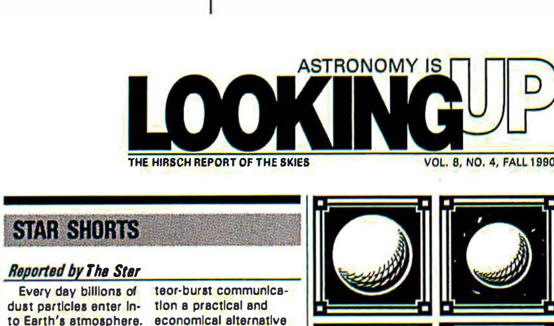
Previous attempts at manufacturing holographic data storage systems failed because it proved impossible to retain the data for more than a few reads. One of MCC's patents concerns a new technique involving static electric fields and polarized laser beams, which allows for a much higher rate of data retention. The other patent concerns the use of an array of crystallites to store data, rather than the previous technique of using a single large crystal.

Holographic data storage works by embedding holographic patterns inside a crystal. Holograms are formed when a reference beam and an image beam of laser light intersect. Multiple holograms

continued

Other laser printers play with one standard dot size.

HP makes it a



ASTRONOMY IS LOOKING UP

THE HIRSCH REPORT OF THE SKIES — VOL. 8, NO. 4, FALL 1990

STAR SHORTS

Reported by The Star

Every day billions of dust particles enter into Earth's atmosphere. Now scientists are working to make meteor-burst communication a practical and economical alternative to the use of tele-

(continued on page 2)

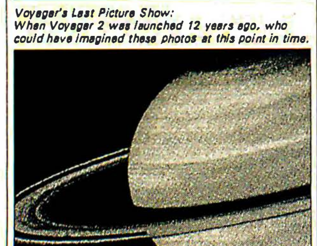
You Can't See the Great Wall from the Moon!

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects; the planet's swift mo-

(continued on page 3)

More on planetary explosions inside.

Voyager's Last Picture Show: When Voyager 2 was launched 12 years ago, who could have imagined these photos at this point in time.



NO BLACK HOLES?

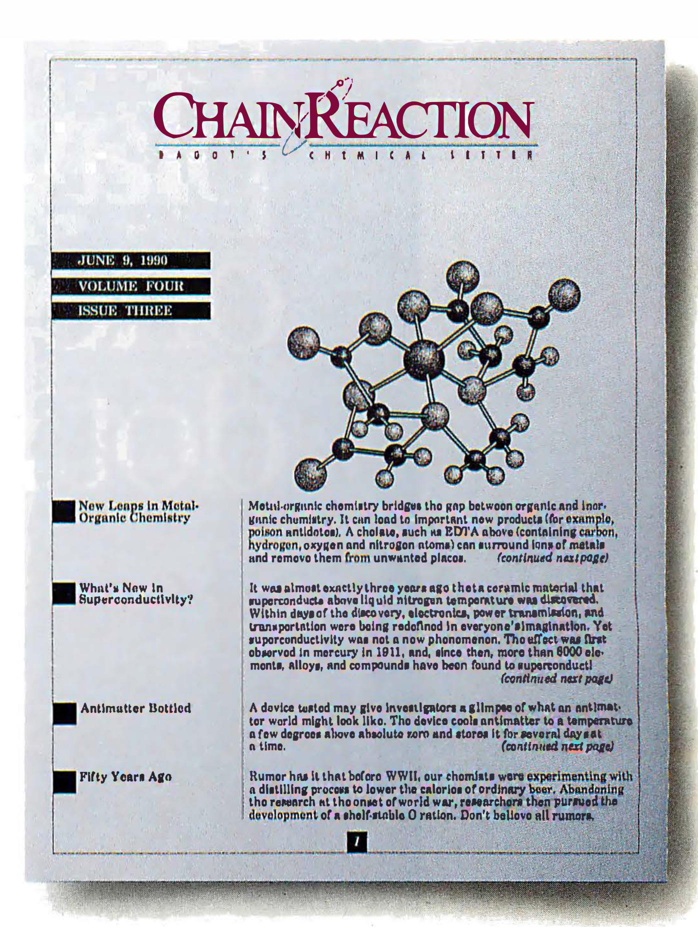
Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

(continued on page 3)

MIRROR, MIRROR

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele-

(continued on page 5)



CHAINREACTION

BAGOT'S CHEMICAL LETTER

JUNE 9, 1990

VOLUME FOUR

ISSUE THREE

New Leaps in Metal-Organic Chemistry

Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A cholate, such as EDTA above (containing carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places. *(continued next page)*

What's New in Superconductivity?

It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct! *(continued next page)*

Antimatter Bottled

A device tested may give investigators a glimpse of what an antimatter world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time. *(continued next page)*

Fifty Years Ago

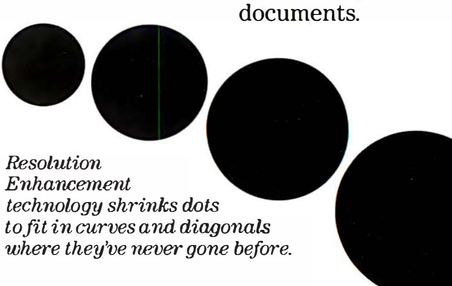
Rumor has it that before WWII, our chemists were experimenting with a distilling process to lower the calories of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shelf-stable O ration. Don't believe all rumors.

1

Introducing the new HP LaserJet III printer with Resolution Enhancement technology.

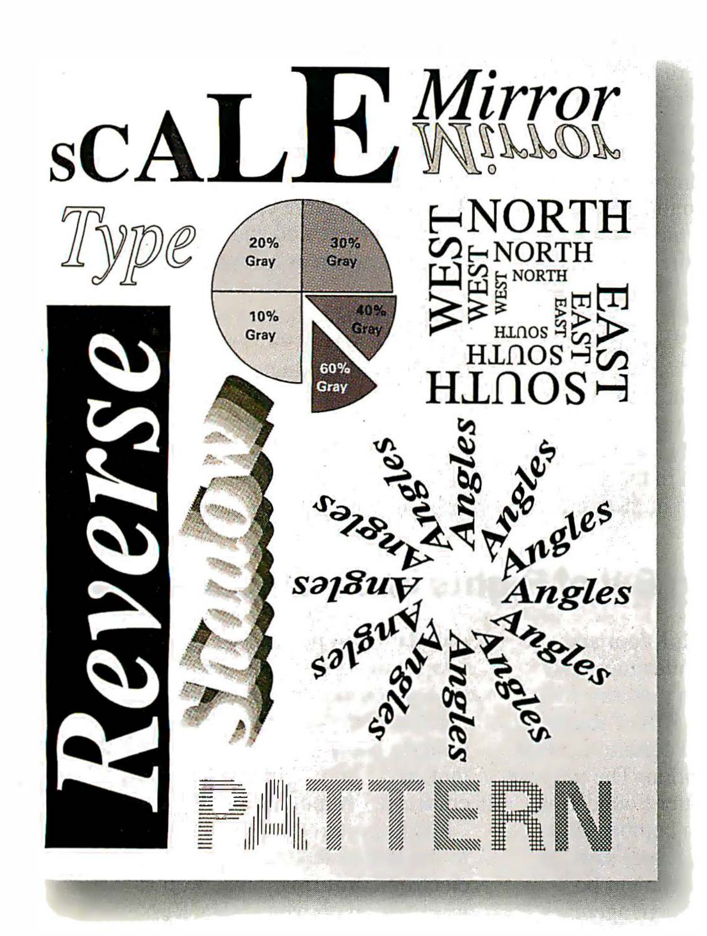
The rules have changed. Now the name of the game is Resolution Enhancement technology. You'll call it the best thing to happen to laser printing since the very first HP LaserJet printer. It gives you clearer resolution. Curves that really curve. And edges that are never jagged.

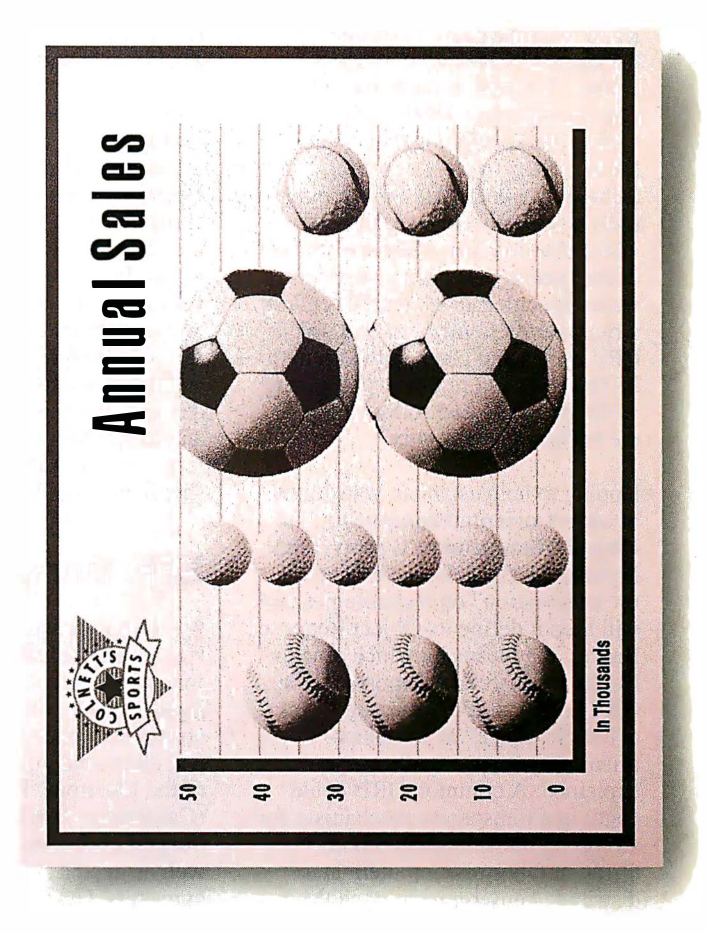
Instead of a "one-size-fits-all" dot, HP's built-in intelligence varies dot sizes. So they can fill areas where they could never go before. For clearer, more professional-looking documents.



Resolution Enhancement technology shrinks dots to fit in curves and diagonals where they've never gone before.

whole new ball game.





But there's more than better print quality. 14 bit-mapped fonts and 8 internal scalable typefaces provide thousands of options. And enhancements to our PCL5 printer language, including our HP-GL/2 graphics language, let you print portrait and landscape on the same page. Reverse and angled type. Spirals. Even shaded text. You can also plug in Adobe PostScript® software.

For all its new features, the $2,395* list price of the HP LaserJet III is a good deal less than the HP LaserJet Series II printer it replaces. With the same hardware compatibility, wide range of applications, 8 ppm print speed, and software compatibility, including WordPerfect 5.1 and WordStar® 6.0. And the same reliability as the rest of the HP printer family.



So call **1-800-752-0900, Ext. 1007.** Ask for our booklet on Resolution Enhancement technology and where to find your nearest authorized HP dealer. We'll put you in a whole new league.

There is a better way.



*Suggested U.S. list price. WordStar is a U.S. registered trademark of WordStar International Incorporated. Adobe and PostScript are registered trademarks of Adobe Systems, Inc.

NANOBYTES

Intel (Santa Clara, CA) has a new single-chip **cache memory controller for 386-based systems** that's designed around the advanced cache built into the i486. Intel claims that the new 386 SmartCache chip (more formally called the 82395 DX), which integrates 16K bytes of static RAM with the cache controller, is the equal of 128K-byte memory caches. The new million-transistor chip incorporates 1000 cache tags as well as the control logic and static RAM. The chip uses a caching technique called write-buffer, essentially a write-through cache with a 128-bit buffer. This eliminates much of the typical delay associated with write-through caches, which need to write directly to memory and use CPU cycles and bus bandwidth to do it. The CPU can return to processing while the cache controller handles the buffering to memory.

Hoping to help establish **standards in object-oriented computing**, the **Object Management Group** (Framingham, MA) has issued a "request for information" on technologies that will help it define its Object Request Broker, the means by which objects handle requests and responses. The ORB is the "primary message delivery vehicle" in an object-oriented system, a spokesperson explained. A common ORB could result in a transparent mechanism for swapping information between different types of computers in a distributed environment, the OMG says. If you're interested in working with the OMG, phone (508) 820-4300 or fax (508) 820-4303.

The new **wristwatch pager** from **AT&E** (San Francisco) and **Seiko** could change the definition of remote communications. The Seiko Receptor MessageWatch Receiver's most remarkable achievements are in miniaturization: The device contains a digital watch, an LCD, an FM receiver, and microelectronics (intelligence and memory) in a package slightly larger than a wristwatch. The chip set used in the Receptor **might find its way into laptop computers**, AT&E says. The paging system relays messages using phone networks and subcarrier FM channels.

are stored in a single crystal by altering the angle at which the beams enter the crystal. At the intersection point of the two beams, a standing wave is formed, similar to light interference patterns. The pattern is stored by a charge field that captures photo electrons from the beam. If the reference beam is retransmitted to the crystal, the holographic image is regenerated and can be read. However, during this readout, the electronic charge pattern is weakened, and after a few reads, it disappears.

MCC's technique to get around this involves using a strong electric field 90 degrees out of phase and converting the electron charge pattern to an ionic charge pattern. This ionic pattern is not destroyed by reads in the same manner as the electron pattern. "We have not yet assessed if you can let this pattern sit for years and years," warned MCC's Jerry Willenbring.

Another technique that MCC has developed and patented involves using an array of crystals rather than a single large crystal. Although in theory there should be no difference in the storage capabilities, using an array has a number of practical advantages, including eliminating "cross talk." Cross talk is an interference problem caused by the laser beam activating an adjacent hologram that interferes with the data readout. Using an array of crystals eliminates cross talk between adjacent holograms. MCC plans to use stacks of pages to store data and is limiting each crystal to a single stack. Using multiple small crystals in an array also has cost benefits. It's far more difficult to artificially grow large crystals than small ones, so it's cheaper to use a cluster of bonded crystals rather than a single large crystal. Also, an array can be scaled and enlarged as required, whereas a single large crystal cannot.

MCC plans to have a working storage device by early 1992 and to have commercial products by 1995. The holographic storage modules will be ideal for computer storage applications, as well as for use in digital high-definition TV, video, and audio.

—Owen Linderholm

EFF: Bringing Bill of Rights into Computer Age

Lotus founder Mitch Kapor and several industry colleagues have formed an organization they say will fight to ensure that the Bill of Rights covers computer-based communication and electronic information. The purpose of the Electronic Frontier Foundation (Cambridge, MA) is to combat violations of civil liberties, Kapor says, as well as to educate government policymakers, law enforcement agencies, and the public about computers.

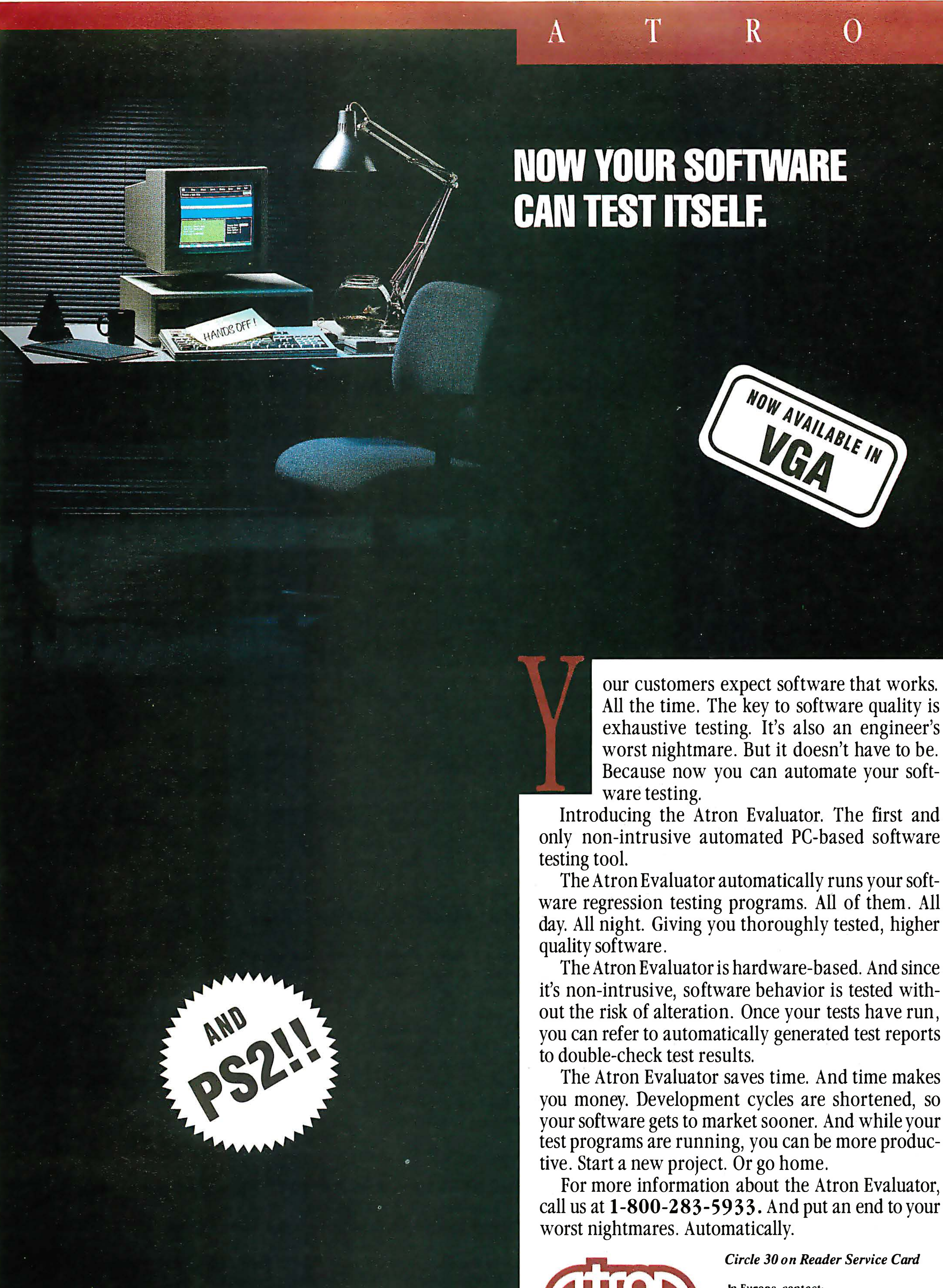
The EFF has taken heat from some members of the industry because they see it as simply a "hacker defense fund," and some law enforcement officials are not necessarily in favor of it. "It's as if NOW started a foundation to come to the assistance of [people charged in] rape cases," says Don Ingraham, chief of the high-tech crime team and an assistant district attorney for Alameda County in northern California. "We don't know what to think of it." He says he doesn't understand why the computer industry would defend people trying to break into their systems.

But Kapor says that is not the organization's purpose. "Unauthorized entry into computer systems is an improper act," he stresses. "It ought to be illegal. It's not the mission of the foundation to provide legal defense for people who break into computer systems. If people are ripping off credit card numbers and posting them on bulletin boards, there are laws about that, and I hope they're appropriately enforced," Kapor says.

It is important that freedoms provided in the Bill of Rights be associated with electronic information as well as information on paper, says Russell Brand, senior computer scientist for Reasoning Systems and a government consultant on computer security. "Paper is archaic," he says. "If your civil rights become attached to paper, they become archaic, and you lose. The Bill of Rights has to be attached to all forms of technology." Even in the case of suspected criminals, due process needs to be followed. "Privacy issues start with the people you hate," he says.

Ingraham points out that authorities have to be able to search computers for incriminating evidence; otherwise, it's like freeing people from being searched as long as they can afford a computer. And the computer itself, as well as the hard disks containing data, must be seized to guarantee that the evidence came from a defendant's computer rather than that of the DA's office, he

continued



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NANOBYTES

Apple Computer reversed its 1987 decision to spin software development off into a separate company and will keep **Claris** as a fully owned subsidiary. Claris, which had planned excursions into Windows and maybe even the exotic lands of OS/2 and Unix, will now focus its development and marketing efforts on its flagship applications, such as ClarisCAD; extensions to Apple's system software; and products that link the Macintosh with other computing environments. "There will be a greater emphasis on software as a point of differentiation in coming years in the industry," said Apple spokesperson Chris Escher. "We want to maximize our software differentiation and get optimized applications out there."

Dayna Communications plans to soon ship a new series of Ethernet cards for Mac IIs and SE/30s. The new DaynaPort for Ethernet cards are based on technology licensed from Novell's Kinetics division and will cost $495.

Mr. Jobs' Journal: Former BYTE West Coast bureau chief Nick Baran plans to launch this month a **newsletter covering the NeXT Computer** and related subjects. *Baran's Tech Letter* will aim to provide users and developers with news and analysis of products and technology issues. A subscription to the monthly, advertising-free publication is $125. For more information: P.O. Box 876, Sandpoint, ID 83864, (208) 265-5286.

Sorry you bought those Billy Joel compact disks? Want to swap that Paula Abdul for The Ramones? Call the **Compact Disc Exchange** (San Francisco), a new electronic BBS for buying and selling music CDs. There's also an area for "gabbing about music," says system operator Wayne Gregori. For every disk you sell (the average price on the board is about $10), CDE takes "a small percentage of the sale as a fee." As Gregori says, the system is especially useful for music listeners living in small towns or rural areas, where you're more likely to find used 45s than used CDs for sale. To go online, dial (415) 824-7603.

says. Ingraham stresses that law enforcers do follow the laws. "If the argument is with the way the stuff is seized, then they're barking up the wrong tree."

With the EFF, Kapor hopes to educate law enforcement officials on technical fine points. "We haven't spoken yet with law enforcement officials, but we're trying to find occasions to get across a table from each other and talk." One of the group's first steps was a grant to Computer Professionals for Social Responsibility, which will use the money for its Computing and Civil Liberties Project. CPSR will also conduct "policy roundtables" with computer users, hackers, lawmakers, the FBI, and industry representatives.

—Sharon Fisher

Superconductor Chips Now Rolling Off the Line

Superconductors hold mighty potential, but researchers are still working on real-life applications. Now a small Silicon Valley start-up is doing something that should lead to superconductor-based products. Conductus (Sunnyvale, CA) has started producing superconductor chips that could be the brains of superfast computers and advanced communications systems. Superconductors allow electricity to pass through them with little or none of the resistance that constricts the flow of electricity in conventional conductors.

Conductus doesn't do any superconductor research itself but focuses on combining new superconductor technology with existing semiconductor manufacturing methods to build commercially viable products.

Conductus has developed a process that involves placing a thin layer of superconducting film on top of the semiconductor. The technique deposits yttrium barium copper oxide on a 1-inch wafer that's then sliced into chips. The devices have found their way into a number of niche products, Smith said, including a bolometer, which is an infrared sensor for use in space satellites and chemical instruments, and the SQUID (or superconducting quantum interference device), a sensor for detecting magnetic fields.

Among Conductus's current customers are a number of "big companies" that Smith declined to identify. Computer behemoth Hewlett-Packard is among the company's investors, according to a spokesperson.

Conductus is focusing on niche markets because those markets aren't profitable enough for large Japanese and American corporations, many of which are currently developing superconductor applications. The company says that it expects to produce about 12,000 chips annually, which will sell for as much as $1000 each.

—Jeffrey Bertolucci

AMD Selling 80287 Coprocessor for $99

Advanced Micro Devices (Austin, TX) has developed a fully compatible version of the Intel 80287 coprocessor and is selling it for $99.

The AMD 80C287 is the first Intel-based coprocessor from AMD, which currently makes versions of the 286 processor and other ICs. The AMD chip is based on the Intel microcode for the Intel 80287 and is thus completely compatible, AMD says.

The significant difference between AMD's coprocessor and Intel's is the price. AMD is charging only $99 for the 10-MHz version of its 80287 clone, while the Intel chip has a street price of at least $179 for the 8-MHz version and around $210 for the 10-MHz version.

AMD has also introduced a low-power version, designed for use with laptops and notebook-size computers.

—Owen Linderholm

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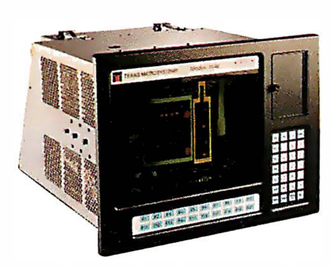
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Maximum expansion slots available	14	5	5
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LETTERS

and Ask BYTE

BYTE Readers Speak on the Future of Computing

Editor's note: *In his May editorial, BYTE editor in chief Fred Langa asked you, our readers, to submit your opinions of the best and worst microcomputing trends or events, as well as your visions of the future of computing. The following letters are some of your responses.*

The best development is the IBM PC with its open architecture. The PC spawned an explosion in the use of personal computers. The power in the PC allowed many individuals to "do their thing" without having to be accountable for the time and money needed, because they did it on their own.

The worst development is MS-DOS. While it was a pioneering effort and had some good features, much more work should have gone into the user interface.

The future will bring more for less. Displays, memory, mass storage, printers, modems, and so on will provide better quality and performance for the price. Quality and support will mean something. The market will require companies to support what they sell. A total rejection of the look-and-feel lawsuits will produce technical advances.

Standards will be developed by design rather than by default. These standards will ensure that the term *compatible* means something.

By 1995, all software will have "smart" installation programs. PCs will be "aware" of the new software. Users will be able to select options by using menus, keywords, voice commands, and touch. The government will provide online database services at little or no charge. Text and video data compression standards, implemented in hardware, will provide immediate viewing with a limited bandwidth for communications. Computers that can talk and understand speech, and cost under $1000, will benefit deaf and blind people.

By the year 2000, we will see very-low-power optical storage in the hundreds of gigabytes to permit a two-level disk access. Less-used programs and data will be "automagically" moved to the second level; frequently used files will reside in the smaller, faster first level. The system will manage disk storage transparently. A standard "data access" computer with a phone connection will replace the telephone. Education for any subject will be available electronically. It will be part of a national education system that provides access to any individual. You will be able to subscribe, using one source, to on-line data from all databases according to your area of interest.

Very little or no distinction will exist between portable and home computers by 2005. Unplug your monitor, keyboard, and local "ISDN-Net," and then pick up your computer and go. Low power consumption and rapid-recharge batteries will power personal computers for 24 hours.

By 2010, all the above will be available in one package, with software preconfigured to meet the needs of the average family, for less than $1000.

Dayne Walker
Oronoco, MN

The best developments over the last 15 years are the emergence of very-large-instruction-word processors, high-level languages such as Prolog, and concepts such as object-oriented programming and the Linda language. The worst was that it took so long.

My wish list for the next five to 15 years includes the following:

- greater portability of software across platforms;
- replacing the keyboard with a microphone;
- a high-resolution (32-bit), full-color, electroluminescent LCD touchscreen, with handwriting recognition abilities, to replace all pointing devices;
- mass storage with gigabyte capacity and no moving parts;
- integrated telephone and computer and a worldwide commitment to broadband ISDN; and
- computerized newspapers, books, dictionaries, encyclopedias, and the like, which would reduce the cost of publishing and make it possible for hypertext-like cross-referencing.

T. Christiansen
Copenhagen, Denmark

What I want is simple: Immortality and infinite power. Lacking that, the more time I can save, the better; the more information I can usefully obtain, the better; and the more fun I can have while doing both, the better.

I will project a pair of reasonable bounds. Naturally, what I project will be wrong, because technological progress is not reasonable. First, the lower bound: a machine that costs no more than a month's pay for a middle-class homeowner—a family car kind of computer. By 2005, this machine will be 15 to 30 times faster than an IBM AT and will have a math coprocessor, 16 megabytes of RAM, as much as 1 gigabyte of optical storage, a high-definition television (HDTV) screen, and full sound-synthesis ability. The main uses of family machines today are text processing and games. In 1995, we'll be able to add household monitoring and security, database and home financial records, and limited communications.

By 2000, most municipalities will have forced cable companies to install two-way amps. Wherever this occurs, there should be an explosion of remote services. By 2005, perhaps we will have the option of voting from home, if verification technology has advanced far enough.

Second, the upper bound: a standard office computer for technical professionals—a machine such as the one I call my "electric secretary." By 2005, this machine will run more than 250 times faster than an IBM AT and have a math coprocessor, 256 MB of RAM, 4 gigabytes of optical storage, an HDTV screen, and full sound-synthesis ability.

By 1995, wherever two-way cable is

continued

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the page and include your name and address. Letters two pages in length or under have a better chance of being published in their entirety. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send letters via BIXmail c/o "editors."*

Your letter will be read, but because of the large volume of mail we receive, we cannot guarantee publication. We also reserve the right to edit letters. It takes about four months from the time we receive a letter until we publish it.

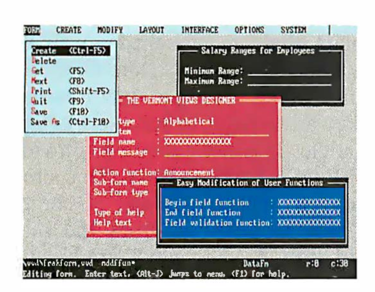
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available, companies will become heavy users of remote data services. After that, it is all blue sky. Depending on the business climate, the nation—and perhaps many nations together—could become a gigantic wide-area network.

Larry J. Van Stone
Stillwater, OK

Alan Huang's breakthrough in photonics and the computer on a chip are the two best computer developments over the last 15 years. The U.S. losing world and domestic market share for semiconductors, computer manufacturing, and robots, as well as the threat of losing HDTV and supercomputer markets, are the worst developments.

What I want in the near future includes an affordable laptop computer for work, learning, and leisure, and an affordable work/leisure multimedia window. While I cannot always get away to enjoy the mountains here in Montana, I want technology to bring the mountains to me. As I work, I want an active window on my monitor where I can choose the weather, the scenery, the location, and a TV channel. I also want to be able to play a game and to choose the color and music. This window would include interactive multimedia help for all computer programs.

I believe that several technologies will be more fully developed. One is the attached computer—putting on your computer will be as common as putting on your clothes. Should it be attached as a vest? In the shoes? Or directly to the body?

Implanted computers would never forget a name of someone you met. Instantly, the implanted computer would be able to reveal the name of the individual and related information.

Another development will be activating computers and robots with body signals. One look at the computer or robot would turn it on to perform tasks. Physical and emotional body signals, such as temperature, cholesterol count, and stress levels, would activate computerized equipment and robots from a distance. The computer would then prepare the environment to receive the human.

Finally, interactive virtual reality will permit you to choose a role and make choices during a video or movie.

Jeanette J. Bieber-Moses
Billings, MT

I would be delighted to contribute to BYTE's anniversary issue. I've often wondered how BYTE has gotten along without me for so long. I've been a devoted reader (off and on, to be honest) for nigh onto 10 years. I noticed that you've invited quite a few others—over a million—but I like big parties.

The future of computing lies in computers providing friendly companionship. We will see expert-system shells preloaded with cultural literacy (including, e.g., some law, science, music, history, and business), and with that elusive and sophisticated competence, common sense. Machines will be comfortably skilled at natural-language input and output.

Each of us will have a computer that goes with us everywhere and gets to know us. It will provide instruction when wanted, play games (including simulating and modeling our fantasies and creative inspirations), and counsel us when we are down in the dumps. It will laugh at our jokes and be amazed, impressed, and outwitted as needed. It will also humbly (but with satisfying bouts of jealousy) encourage us to be involved with other friends, relatives, our jobs, and the activities in life that make computers worthwhile—or is it the other way around?

Richard Crews
San Rafael, CA

Beyond the number games of bigger machines with more speed for the buck, there will be a continued migration of functions into the operating system. The next candidates for this migration will probably be graphical user interfaces (GUIs) and databases.

For those who program in compiled languages such as C, the operating system becomes the environment, and, mediated through standard library routines, it is becoming possible to write high-performance software that uses almost any of a system's capabilities in a way that is portable to other machines. The GUI is the last needed piece for this to happen. It is easy to see why it came last; it is the most real-time and idiosyncratic of the interfaces, making it the hardest to standardize.

Just as file systems arrived a short generation after disk drives, databases are going to layer on top of the file systems to provide a more general way to access all the objects in a computer. The resource fork in Macintosh files is one early indication of the need. The basic idea is not that your file system will contain databases, but that it will be a database with the present directory tree structure as one index in it.

This environment spells the end of the TSR approach, and it leads toward a more consistent look and feel as more of the user interface becomes a system service. But it doesn't tell where the exciting new applications will come from. For that, I'll keep reading BYTE.

Eric Jensen
Bedford, NH

I would like to be able to wear my computer. I would like my computer's output to be a nearly seamless part of my sensory world. My computer should take its input directly from my nervous system. It should monitor and help maintain my bodily functions. Its use should extend my life, as its use enhances the quality of my life now. I don't want to be tied to a desk or a desk-like situation (as with a laptop) to be able to do all this neat stuff.

This technology should lead to the destruction of all forms of authoritarianism. Is that radical enough?

The best developments in computers over the last 15 years have been the availability of public domain and shareware software, without which I could not afford to do much computing, and BBSes—the ideal medium for all us ex-high school nerds.

The worst developments have been the dominance of the segmented Intel architecture and MS-DOS, which is really no friendlier than Unix, and the emergence of men and women with M.B.A.s, boring suits, and not the slightest trace of imagination.

Charles Bridgeland
Urbana, IL

Don't Forget CocoNet

BYTE has done a truly outstanding job in the past in reporting breakthrough trends and new products. It was therefore with great disappointment that we noted our absence from your June article, "DOS and Unix: On Speaking Terms" by Tom Yager. It is especially surprising in light of the favorable review of our product, CocoNet, that you published in your February issue (Reviewer's Notebook).

Our product is unique, and it has several key advantages to solutions noted in the article. It is not enough to provide a TCP/IP DOS LAN on Unix. This simply creates yet another "island of computing" that is divorced from the mainstream of PC LANs, which are NetBIOS or IPX (NetWare) based. Moreover, what is really required is a high degree of integration between Unix and DOS file systems, peripherals, and applications. Unix users must see Unix, and DOS users must see a DOS environment, regardless of file or application location.

continued

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Charles M. Robins
President
Atlantix Corp.
Boca Raton, FL

ASK BYTE 

Tandy TX Revisited

James Erwin wrote with several very good questions about the Tandy 1000 TX in the May issue. While your responses concerning the 8-bit bus of the Tandy TX were correct, there was a major inaccuracy in your description of the video capability.

Pages 24 and 31 of the Tandy Practical Guide to the Tandy TX (which comes with every new Tandy TX) details the video interrupt switch and three other switches that the user can toggle. You can make the Tandy TX fully configurable for virtually any monitor by changing DIP switch 4. For example, I am using a multisync Super VGA monitor and a Paradise 512K-byte VGA board on one Tandy TX. On another, I use a Hercules-compatible graphics card and a Tandy CM-5 high-resolution monochrome monitor.

Quite a lot of controversy has surrounded the options available for the Tandy TX. The four interrupt switches toggle interrupts 5 through 7 and the video mode. I am using a Tandy TX, networked with Artisoft's LANtastic, which is running quite nicely. All I had to do was toggle interrupt 7 to allow the LAN cards to operate.

William L. Kennon
San Diego, CA

Thank you for the clarification.
—Lab Staff

Computer-Aided Translation

I have two questions. First, are there any programs available for translating text from one language to another? Second, could you please direct me to any desktop publishing clubs? My main interest is desktop publishing on Apple computers.

Robert I. Feldman
Lompoc, CA

There are a number of language-translation software packages out there. Translation Support Systems from Automated Language Processing (P.O. Box 87819, Salt Lake City, UT 84108, (801) 584-3000) can handle words and phrases. Two packages from International Computer Products—Learn Spanish and Learn German—are for educational use. Contact International Computer Products at 346 North Western Ave., Los Angeles, CA 90004, (213) 462-8318. Also check out MultiTrans from Microlytics (Two Tobey Village Office Park, Pittsford, NY 14534, (716) 248-9150). PC Linguist from Microtrans (348 Turnstone Dr., Livermore, CA 94550, (415) 447-0596) supports only Russian-to-English-and-back as I am writing this. However, the company hopes to have added support for other languages by the time you read this. Give Microtrans a call and see.

Last but certainly not least, if all you are looking for is automated word-at-a-time translation, there's always DAK's pocket Language Barrier Blaster, a hand-held calculator-style translator that "understands" English, French, German, Spanish, and Italian. Contact DAK Industries (8200 Remmet Ave., Canoga Park, CA 91304, (800) 325-0800).

On the topic of desktop publishing clubs, try contacting the PC Publishers of Northern California at (415) 661-9270. Although you state that you are most interested in Apple software and these guys are MS-DOS-minded, perhaps someone there can direct you to an Apple-specific group.—R. G.

Curious About Coprocessors

We read with interest a recent Under the Hood in BYTE concerning the Cyrix CX-83D87 math coprocessor ("Math Coprocessors," January). Could you provide us with more information? We are a small team of programmers, and we are looking for replacements for the Intel coprocessors (which, in Italy, cost an arm and a leg). We are also interested in further information about the IIT-2C87 and 3C87.

Mannori Simone
Florence, Italy

For more information concerning the Cyrix coprocessor, contact Cyrix Corp. (1761 International Pkwy., Richardson, TX 75081, (214) 234-8388). I'm sure the people there would be happy to send you technical documentation.

BYTE reviewed the IIT-2C87 coprocessor in the September 1989 issue (Reviewer's Notebook). Contact IIT at 2540 Mission College Blvd., Santa Clara, CA 95054, (408) 727-1885, for more information about its coprocessors.—R. G.

Eternal Paper

Do you know of a source for acid-free paper for computer printers and photocopiers? Paper longevity is desirable because you never know what information on hard copy will be important in the far future. A national heritage of data on paper disappears when 15- to 50-year-old paper crumbles. Because of the preservation of the Warsaw telephone directories by the New York Public Library, many of the survivors of the Holocaust were provided with their sole source of documentation for reparations.

My science fiction collection, which I started in the 1960s, is rapidly deteriorating. Although CD-ROM and electronic storage media have their advantages, books have their own peculiar random-access qualities that might never be equalled.

Charles Knickerbocker
East Lansing, MI

There are probably others, but Finch, Pruyn & Co. of Glens Falls, New York, makes a full line of acid-free papers. Contact your local distribution house, and ask for Finch Laser Opaque or Finch Opaque Xerographic paper.

There's another thing to remember about long-term paper storage: The printing itself may be adversely affected by ultraviolet light or heat. After printing your literary gems on acid-free paper, make sure to store them in a dark, cool, dry place. Losing an important 15-year-old printed document can be tragic, but CD-ROM technology may prove to have some problems of its own. I have audio compact disks that date back to 1983 that are no longer playable. I'd like to believe that the bad disks were simply a product of an immature manufacturing process. But until we know more about a CD's life span, I'm not ready to give up on paper, either.—H. E.

Foreign Formats

I often receive data on 5¼-inch floppy disks from other laboratories. The data is either in ASCII files or a form of BASIC. While the disks are ostensibly formatted in an IBM-compatible fashion, I often

continued

have difficulties reading them. Is there a program to help me read such disks?

On another topic, what hypertext-like programs are available for IBM PC compatibles?

V. Ackerman
St. Leonards, N.S.W., Australia

In response to your first question, I'm afraid you haven't described your problem clearly enough. I'm not sure what you mean by "difficulties." Can you at least get a directory of the disk? If not, it's likely that somebody's drive is out of alignment—either yours or the drive of whoever is sending you the disks. Try reading the disk on someone else's machine. If you can do it, the sick drive is probably your own.

Also, be certain that you are not trying to read a floppy disk formatted to a higher density than your system can handle—you can't read a 1.2-MB disk in a 360K-byte drive.

You mention that the files may be BASIC files. Are you trying to read an interpreted BASIC program listing as you would read an ASCII file? If so, you'll see lots of strange characters, owing to the fact that BASIC "tokenizes" files when it saves them to disk. You can read the file by running your BASIC interpreter, entering LOAD "<FILENAME>", and typing in LIST. If you want to save the file in human-readable form, type SAVE "MYFILE.BAS",A, which will copy an ASCII version of the program into the file MYFILE.BAS.

Finally, assuming none of the above suggestions works, you might try some form of disk utility software, such as the Norton Utilities. You'll have to do some real coal-miner's duty to dig the data off the disk; it depends on how desperate you are to recoup the files. The Norton Utilities are available from Peter Norton Computing, 100 Wilshire Blvd., Ninth Floor, Santa Monica, CA 90401, (213) 319-2000.

And, yes, there are a number of hypertext-like programs for the PC. Here are a few that you could look for:

Guide
Owl International
2800 156th Ave. SE
Bellevue, WA 98007
(206) 747-3203

Coretext
Samna, Inc.
5600 Glenridge Dr.
Glenride Center
Atlanta, GA 30342
(404) 851-0007

Plus
Spinnaker Software
One Kendall Sq.
Cambridge, MA 02139
(617) 492-1234

Object-Script
Matesys
2001 L St. NW, Suite 801A
Washington, DC 20036
(202) 785-0770

—R. G.

Chickens, Eggs, and Compilers

I am still amazed at compilers; how can a compiler translate a program into machine language? Is the compiler constructed using assembly language? If so, how do you make an assembler, such as Microsoft's Macro Assembler? Furthermore, how do you create an operating system, since that must be built before anything else?

Kabul Suwitaatmadja
Bandung, Indonesia

Your one-sentence questions would require pages to compose an adequate response. I'll handle those that I can here and then suggest some books that should get you the rest of the way.

Currently, commercial compilers are written in high-level languages such as C or Pascal. Of course, since the source code for the compiler has to be compiled by another compiler, you're understandably led into a chicken-and-egg question: Who wrote the first compiler?

Although there was no single primordial compiler, it is true that in the prepubescent days of the digital computer, most work was done in machine language. Programmers sat in front of a panel of switches and toggled bit patterns in one memory location at a time. (In fact, when IBM released FORTRAN, circa 1957, the company had to embark on a large sales campaign to convince its machine-language-entrenched customers of the benefits of a high-level language.) You can get a taste of what it must have been like to put a high-level language together in machine language by scanning through early issues of Dr. Dobbs Journal of Computer Calesthenics and Orthodontia, *where you'll find the source code for Tiny BASIC (a later version of Tiny BASIC for the 68000 appeared in a more recent issue). Granted, that limited version of BASIC ran on CP/M machines, but I have seen a Tiny BASIC for MS-DOS available from several of the public domain and shareware software houses.*

For further reading in compiler construction, I suggest Programming Language Translation: A Practical Approach *by Patrick D. Terry (Reading, MA: Addison-Wesley, 1986) and* Compiler Design in C *by Allen I. Holub (Englewood Cliffs, NJ: Prentice-Hall, 1990).*

For information concerning the design and implementation of operating systems, look for Operating Systems: Design and Implementation *by Andrew S. Tanenbaum (Englewood Cliffs, NJ: Prentice-Hall, 1987).—R. G.*

They Just Fade Away

I have a problem with the plasma screen on my Ogivar Technologies 286 laptop computer: It's dying. When the problem first appeared a few months ago, it was negligible. Only a few pixels on the edge of the screen were dead (i.e., dark spots appeared on the orange screen). Recently, the situation has deteriorated rapidly. About one-half of the screen is affected with the dying pixels. It looks as though someone left finger scratches all over it. Characters in the affected areas are only partially visible, which makes them difficult to read. Can you help?

Brett Cui
New York, NY

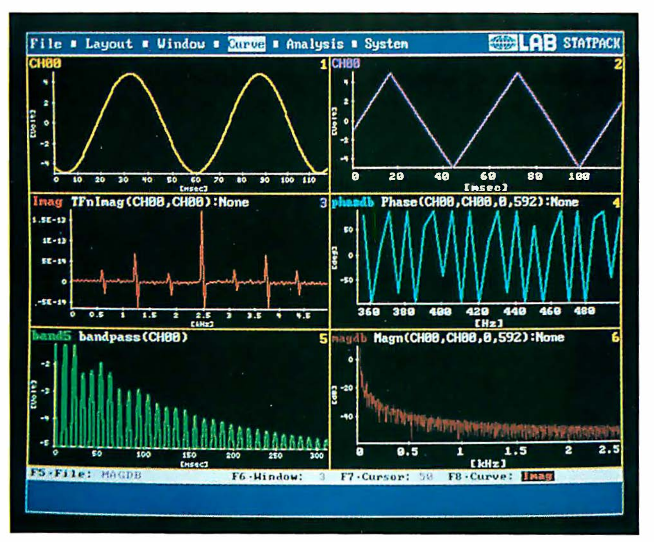
You're not alone with your dying plasma screen. A number of plasma screens are dying a similar death; it largely depends on the quality of the individual manufacturing runs.

I asked Ogivar about your computer, the Ogivar 286 System 4, and the people there haven't heard about any of their screens dying like that. I would encourage you to return the unit to them for repair. Contact Ogivar at 7200 Trans-Canada Hwy., Ville-Saint Laurent, Quebec, Canada H4T 1A3. Call the company first at (514) 737-3340 to make arrangements. Your unit apparently has a one-year warranty, and you may be able to arrange a warranty repair, even if it's past the period. Ogivar's customer-support people were sympathetic to your problem and seemed eager to resolve it.—H. E.

FIXES

The lapAdapt plug adapter listed in the May What's New section allows devices with a standard American three-blade grounded plug to be connected to British and European grounded plugs while maintaining the integrity of the ground. It doesn't function as a current adapter/converter. ■

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—Fred Molinari, President

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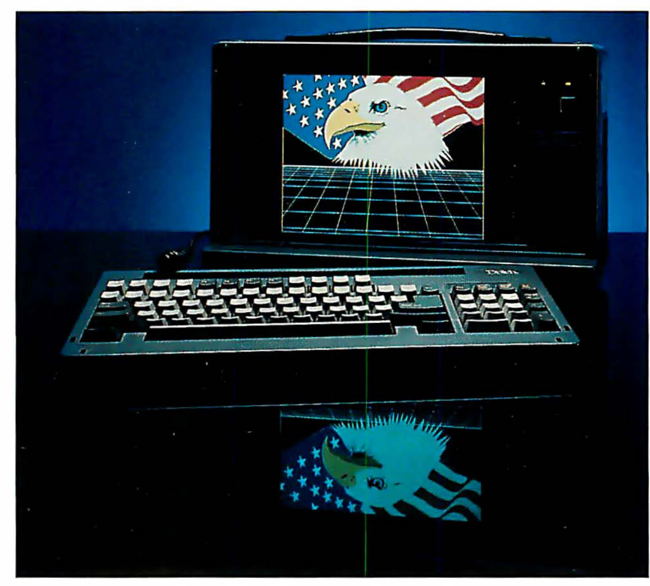
Circle 83 on Reader Service Card

Portables Feature Color and Desktop Performance

Full-color VGA 386 portables are now available from several manufacturers.

The new Dauphin has a high-contrast, active-matrix (or thin-film transistor) LCD screen like the Macintosh Portable. But the Dauphin system takes the technology a step further with a just-released color LCD combined with fluorescent backlighting by Hitachi.

The Dauphin system is an 18-pound 386SX laptop. It features a 3½-inch 1.44-MB floppy disk drive, a 20-MB hard disk drive, and a 92-key keyboard.
Price: $9995.
Contact: Dauphin Technology, Inc., 1125 East St. Charles Rd., Lombard, IL 60148, (708) 627-4004.
Inquiry 1120.



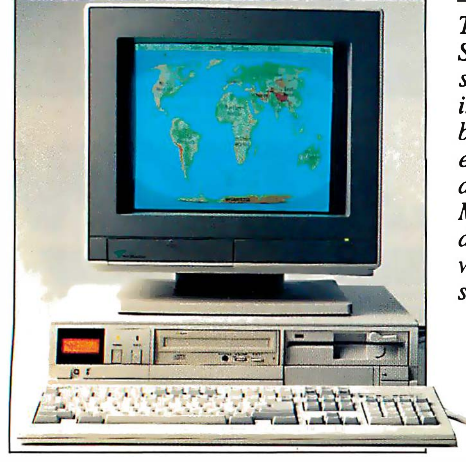
Color graphics and your choice of 386 or 486 performance are combined in the 20-pound Dolch portable.

For a portable with color and 386/486 performance, Dolch Computer Systems offers the Hitachi thin-film transistor, active-matrix color screen with its new 386 TFT-Color Portable and 486 TFT-Color Portable. Each system weighs about 20 pounds.

Standard features on the 25-MHz 386 TFT-Color Portable include 32K bytes of RAM cache, 2 MB of RAM, and a 5¼-inch floppy disk drive. The 25-MHz 486 TFT-Color Portable includes 8K bytes of RAM cache, 2 MB of RAM, and a 5¼-inch floppy disk drive.
Price: 386, $11,990; 486, $16,990.
Contact: Dolch Computer Systems, 2029 O'Toole Ave., San Jose, CA 95131, (408) 435-1881.
Inquiry 1121.

If you need a lower-cost 386 portable and can forgo color, you might consider the MP200 from Micronics. The 25-MHz 386 measures 4 by 16 by 14¼ inches, weighs 14 pounds, and has a 10-inch 640- by 480-pixel backlit LCD or gas-plasma display.

Standard features include 1 MB of RAM (expandable to 8 MB) and 32K bytes of cache memory. Also included are a 40-MB 25-ms hard disk drive and a 3½-inch 1.44-MB floppy disk drive.
Price: $6500.
Contact: Micronics Computers, Inc., 232 Warren Ave., Fremont, CA 94539, (415) 651-2300.
Inquiry 1122.



The Sun Moon Star CD-ROM system comes inexpensively bundled with eight CD-ROM disks and a 40-MB hard disk drive packed with conventional software.

Sun Moon Star Bundles CD-ROM, Disks, and 286

The Sun Moon Star CD-ROM system consists of a 12-MHz 286 with 2 MB of RAM, a 40-MB hard disk drive, two-channel audio output, a 14-inch color VGA monitor, and a CD-ROM drive.

The CD-ROM drive comes with automatic installation software along with Microsoft Bookshelf, Microsoft Small Business Consultant, Microsoft Stat Pak, Hotline II Executive, Software Toolworks Illustrated Encyclopedia, Software Toolworks World Atlas, Software Toolworks CD Game Pack, and the CD Audio Guide.

The hard disk drive comes preloaded with DOS 3.3, GEM/3 Desktop, GEM Draw, PFS:First Choice, and CheckIt.
Price: $2995.
Contact: Sun Moon Star, Personal Computer Division, 1941 Ringwood Ave., San Jose, CA 95131, (408) 452-7811.
Inquiry 1123.

386SX Touchscreen Portable

The Datellite 300L is a 7-pound 16-MHz 386SX portable without a keyboard. You enter information via the VGA-resolution touchscreen that you use like a clipboard, saving completed forms on a 3½-inch 1.44-MB floppy disk drive, a 40-MB hard disk drive, or a 120-MB hard disk drive.

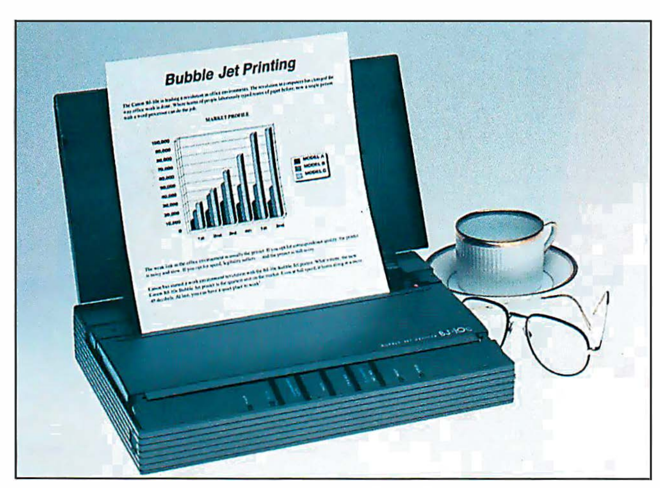
Standard features of this 12⅝- by 10- by 2¾-inch portable include 1 MB of RAM (expandable to 16 MB), a parallel port, a serial port, a 4-hour battery, and DR DOS. The system also comes with an application-generator software package.
Price: Floppy disk version, $5995; with 40-MB hard disk drive, $6995; with 120-MB hard disk drive, $7995.
Contact: MicroSlate, Inc., P.O. Box 2207, Stamford, CT 06913, (203) 357-9901.
Inquiry 1124.

Tiny Printer Doesn't Compromise on Paper or Speed

The BJ-10e is an inexpensive 4-pound portable printer that lets you use standard 8½-inch-wide paper instead of hard-to-handle thermal paper. It uses a 64-nozzle bubble-jet print head and snap-in ink cartridges that each print about 700,000 characters in a high-quality mode.

If you're in a hurry, the BJ-10e prints in both directions at up to 360 dpi. It emulates both the IBM Proprinter X24E and the Canon BJ-130e and offers a high-quality mode in which it can print at up to 83 cps. The input buffer is 3K bytes with an additional 34K bytes reserved for fonts. You connect it to your computer's parallel port, and it draws power from its included 1$\frac{3}{10}$-pound AC adapter or from an optional battery.

Pitch selection includes 10, 12, or 17 cpi in addition to proportional spacing. The printer measures 12¼ by 8½ by 1⅞ inches.
Price: $499; print cartridge, $25; battery, $50.
Contact: Canon USA, Inc., Printer Division, One Canon Plaza, Lake Success, NY 11042, (516) 488-6700.
Inquiry 1125.



Canon's BJ-10e printer is small, inexpensive, and light.

Nisca's Gray-Scale Scanner Fits in Your Hand

The Niscan/GS is a hand-held scanner that can scan up to 256 levels of gray with hardware gray scaling and at resolutions of from 25 dpi up to 400 dpi in either 16 or 256 levels of gray. The width of the scanning window is 4⅕ inches, and the unit can scan images up to 11 inches long.

The scanner comes with an interface board for the IBM PC and GEM-based scanner control software. The software offers a number of advanced gray-scale editing capabilities: adjustment of image brightness and contrast without having to rescan; scaling, cropping, and cutting and pasting; flipping, rotating, and zooming; and paint tools for touching up. It also lets you gamma-correct images (gamma correction is a technique for globally adjusting individual shades within an image to enhance details or tone down bright areas). You can save images as PCX, IMG, or TIFF files.
Price: $369.
Contact: Nisca, Inc., 1919 Old Denton Rd., Suite 104, Carrollton, TX 75006, (800) 245-7226.
Inquiry 1126.

Cheaper Color PostScript Printing with Seiko Unit

The ColorPoint PS is a thermal-transfer printer built around a controller based on Intel's i960 RISC processor. For a PostScript interpreter, it uses PhoenixPage from Phoenix Technologies.

The unit prints at 300 dpi and comes with five communications interfaces: serial, parallel, AppleTalk, and two SCSI. The system scans each port looking for data from the different computers. It also comes with 35 LaserWriter NT-equivalent fonts.

The ColorPoint PS comes with 6 MB of memory. The standard ColorPoint PS prints an 8¼- by 10$\frac{7}{10}$-inch image on an 8½- by 11-inch page. The printer also comes in an optional B size that can print images as big as 10¾ by 16⅗ inches.
Price: $6999; B size, $9999.
Contact: Seiko Instruments USA, Inc., Graphic Devices and Systems Division, 1130 Ringwood Court, San Jose, CA 95131, (408) 922-5800.
Inquiry 1127.

Device Makes Photographic Prints

The UP-3000 color printer produces near-photographic-quality 4- by 3-inch prints with 256 levels of color from a palette of more than 16 million colors. You can use the device, which is about the size of a 9-pin printer, to print from your computer (via the RS-232C port) or from RGB analog, composite video, and still video devices.

Using a dye-transfer thermal printing technique with 512 elements on the thermal head, the UP-3000 can produce full-size 4- by 3-inch images, four images on the same sheet, or 25 "thumbnail-size" images on a single page. It takes about 80 seconds to produce a print, whether you're simply printing from the screen or from a picture (i.e., making a mirror image), or whether you've added comments to the prints outside the picture area.

Standard equipment on the 17- by 5- by 17¼-inch printer includes front-panel controls, remote control, 40 sheets of printing paper, and a menu-driven monitor display. You can adjust image and color with controls for separate red/green/blue mixing, sharpness, picture focus, brightness, and hue.
Price: $3895.
Contact: Sony Corp. of America, Sony Dr., Park Ridge, NJ 07656, (201) 930-6432.
Inquiry 1128.

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continued

Modules Convert 386 Systems to 486 Systems

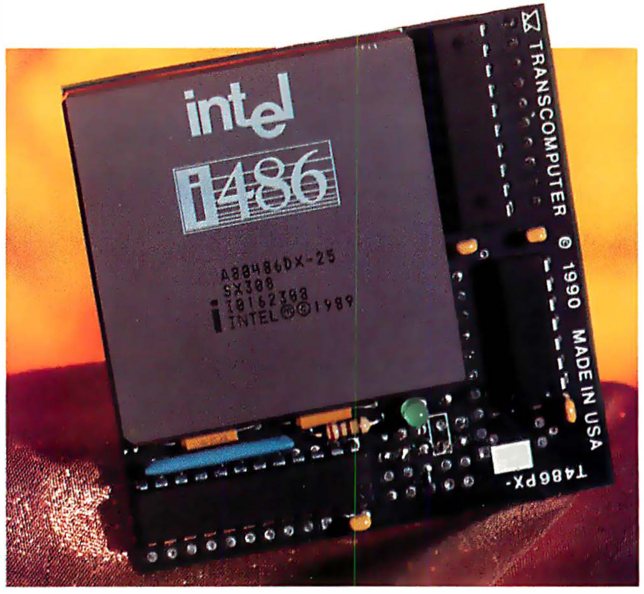
Interested in high-speed i486-based systems? Two companies have i486 CPU modules that plug into your 386 motherboard and let you take advantage of the i486.

The new Trans486PX CPU Translator Module from TransComputer is a small (2½- by 2½-inch) board that has all the circuitry needed to make a 386 system think it is talking to an ordinary, if somewhat fast, 386. The manufacturer claims that the module can deliver a three- to fivefold increase in performance.

But the module may not work right away with every 386-based system. TransComputer says that right now it works only with "standard" 386-based machines, including most systems that use Chips & Technologies chip sets. Not included in this standard list, however, are computers from IBM, Compaq, AST, Advanced Logic Research, and Epson.
Price: Without an i486, $486; with an i486, $1686.
Contact: TransComputer, Inc., 1257 Tasman Dr., Sunnyvale, CA 94089, (408) 747-1355.
Inquiry 1129.

According to Feith Systems, the Feith 486 Gold Card, an i486 CPU module for your AT&T WGS 386, lets your existing software run from two to four times faster and is compatible with all DOS and Unix software.

The module also features an on-chip floating-point processor, a memory cache, and 8K bytes of unified code and data cache.
Price: $5295.
Contact: Feith Systems and Software, Inc., One Bala Plaza, East Lobby, Bala Cynwyd, PA 19004, (215) 667-5575.
Inquiry 1130.



CPU modules from TransComputer and Feith Systems can add 486 performance to your 386-based system.

Accelerate Your Graphics

An inexpensive way to quickly display graphics on VGA and higher-resolution monitors is by using Number Nine Computer's Graphics Xccelerator in conjunction with a video controller. In VGA mode, the #9GX is as much as 25 times faster than VGA cards without a graphics accelerator.

Each #9GX has a 60-MHz TMS34010 processor, 512K bytes to 2 MB of video RAM, and up to 4 MB of DRAM. It speeds graphics on computers with ISA and EISA buses and is compatible with screen resolutions ranging from standard VGA (640 by 480 pixels) up to 1280 by 1024 pixels with 256 colors. It can also address a bit map as large as 4096 by 4096 pixels. You can increase the resolution, color depth, and speed by adding more memory and changing the driver.
Price: $895.
Contact: Number Nine Computer Corp., 725 Concord Ave., Cambridge, MA 02138, (800) 438-6463 or (617) 492-0999.
Inquiry 1134.

continued

VGA Boards Reduce Eyestrain

Several manufacturers have introduced VGA controllers that are designed to reduce eyestrain, with refresh rates of between 70 and 75 Hz rather than the customary 56 or 60 Hz.

The Sigma VGA Legend, with a refresh rate of 72 Hz, displays graphics at 1024 by 768 pixels, 800 by 600 pixels, and 640 by 480 pixels. Each board includes 512K bytes of RAM and is user-expandable to 1 MB (for high-resolution display with 256 colors).

Supported monitors include the Nanao FlexScan 9070, NEC's MultiSync 4D and 5D, Sony's CPD-1304, Mitsubishi's Diamond Scan 16L and 20L, Hitachi's Hi-Scan 20, and the Relisys RE-1520.
Price: $449; 1-MB version, $569.
Contact: Sigma Designs, Inc., 46501 Landing Pkwy., Freemont, CA 94538, (415) 770-0100.
Inquiry 1131.

Genoa Systems says that its Super VGA controller cards provide flicker-free resolution using a new application-specific IC chip. The company's 16-bit (Model 6400A) and Micro Channel architecture (Model 6600A) graphics controller cards provide 70- to 75-Hz screen refresh rates at a screen resolution of up to 1024 by 768 pixels.
Price: Model 6400A, $499; Model 6600A, $549.
Contact: Genoa Systems, Corp., 75 East Trimble Rd., San Jose, CA 95131, (408) 432-9090.
Inquiry 1132.

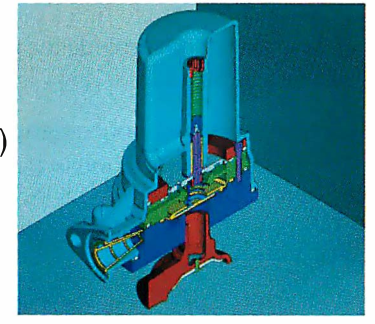
Tatung's inexpensive OmniVGA/HR video controller cards offer a 70-Hz vertical operating frequency, 1024- by 768-pixel resolution, and backward compatibility with Super VGA, VGA, CGA, EGA, Hercules, and Monochrome Display Adapter monitors.

Model 512 can concurrently display up to 256 colors; Model 256 can display up to 16 simultaneous colors.
Price: OmniVGA/HR-256, $289; OmniVGA/HR-512, $339.
Contact: Tatung Company of America, Inc., 2850 El Presidio St., Long Beach, CA 90810, (213) 979-7055.
Inquiry 1133.

The IBM RISC System/

Designing on any other workstation

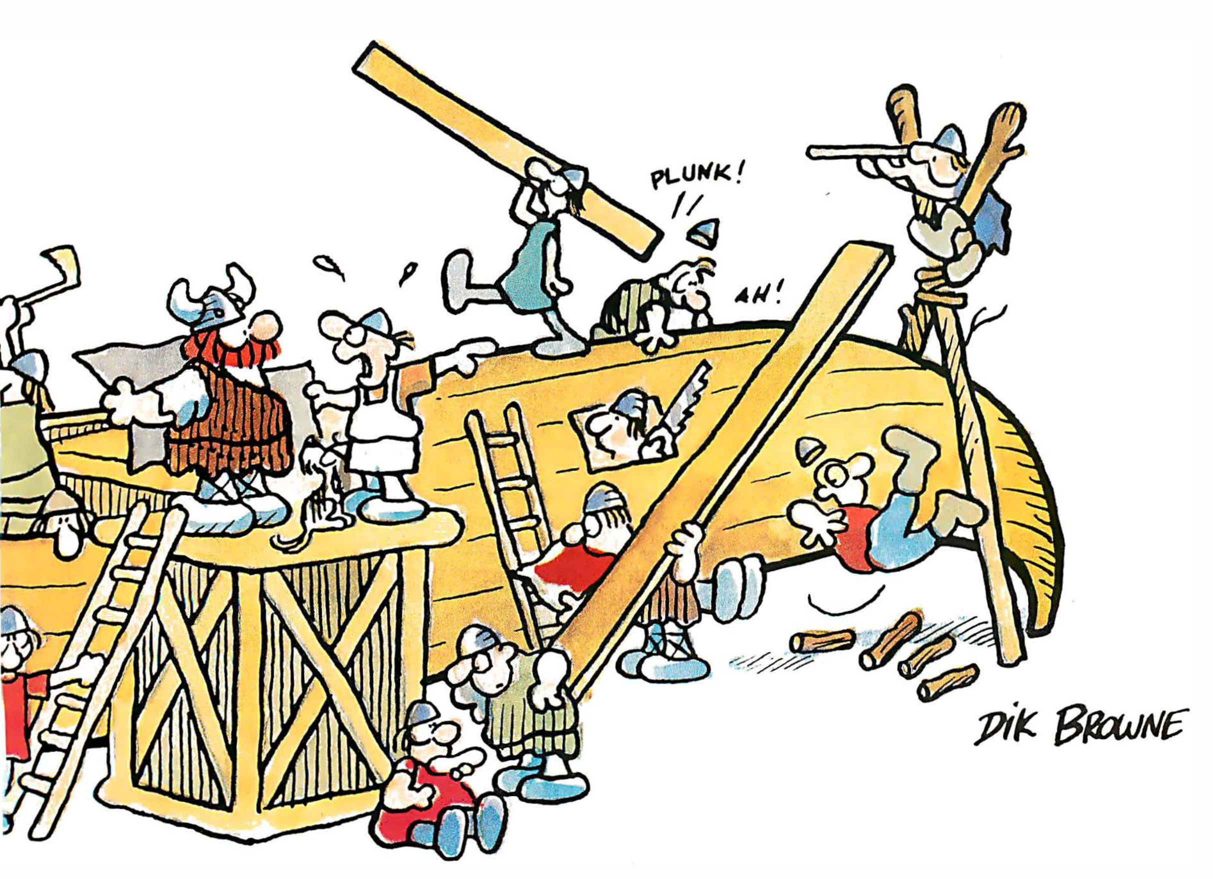
Whatever you're creating, you'll sail into a whole new age with any of the four POWERstations in the RISC System/6000 family. Because POWER (Performance Optimization With Enhanced RISC) processing can give you performance you've probably only dreamed about:



up to four instructions per machine cycle, 42 MIPS and 13 MFLOPS. Suddenly, complex designs don't take eons anymore.

The four RISC System/6000 POWERstations feature a range of graphics processors from grayscale to Supergraphics to satisfy any graphics demand. Great news for Power Seekers working on animation, scientific visualization, medical imaging and engineering solutions like CADAM,™ CAEDS™ and CATIA.™ And for electrical design automation, there's IBM's all new CBDS™ and an arsenal of over 60 EDA appli-

6000™ family.
will seem downright primitive.



cations from more than a dozen vendors.

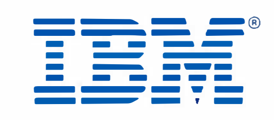
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Circle 141 on Reader Service Card

Share a PostScript Printer Among PCs and Macs

If you need to connect both PCs and Macs to a single PostScript printer, you should consider BridgePort, a small peripheral from Extended Systems.

Macintoshes connect to BridgePort through the LocalTalk interface (which supports up to 31 Macs), and as many as two PCs can connect through the serial and parallel interfaces. Integrated LaserWriter emulation lets your Mac print PostScript files to non-Apple printers.

BridgePort supports several printers, including Hewlett-Packard's II, IID, and III printers equipped with a PostScript cartridge; IBM LaserPrinters equipped with PostScript; QMS PS810 Turbo printers; Apple LaserWriter IINT and IINTX printers; and other compatibles.

Price: $495.

Contact: Extended Systems, Inc., 6123 North Meeker Ave., Boise, ID 83704, (208) 322-7575.

Inquiry 1135.



One BridgePort lets you inexpensively share a PostScript printer among two PCs and as many as 31 Macs.

"Camera" Prints on a PostScript Printer

The Dycam 1GS is a battery-operated still-video camera you use to take pictures, display and edit them on your Mac, and print them on your PostScript printer. Dycam plans to introduce a PC version later this year.

The charge-coupled device operates much the same as an ordinary film camera. You point and shoot, and an audio-output shutter click confirms that you've captured the image. The Dycam 1GS has shutter speeds of 1/30 to 1/1000 second, depth of field from 2 feet to infinity, a "perfect portrait" field of view, and a variety of beeps to signal that you're about to take a bad picture, that the Dycam's battery is low, and other problems.

After you snap your pictures, you drop the unit into a cradle that connects it to your computer's serial port. Software running on the Mac includes a menu selection for uploading the images at a rate of about 20 seconds per photograph. You can then display and edit the image using such packages as Digital Darkroom.

Maximum image quality is rated as 376 by 240 pixels in 256 shades of gray. The unit weighs 10 ounces.

Optional accessories include a kit with a recharger, another recharger that plugs into an automobile cigarette lighter, and a laptop cable and cable adapter.

Price: $995.

Contact: Dycam, Inc., 9546 Topanga Canyon Blvd., Chatsworth, CA 91311, (818) 998-8008.

Inquiry 1136.

Two New Cartridges for Your LaserJet Printers

The Charisma cartridge, for all Hewlett-Packard LaserJet printers, lets you plug in up to four extra single-chip modules to add functions to your printer.

It contains all the font and symbol sets from the standard HP A-through-Z font cartridges, as well as a number of additional symbols and fonts (including extra large). Elite has announced 12 modules for Charisma, including traditional typefaces.

The company also plans to provide a service to allow you to place any graphics image on a module. Images include company logos, letterhead, or other commonly used and complex figures.

Price: $399; modules, $99 to $149.

Contact: Elite Business Applications, 28 Route 3 North, Millersville, MD 21108, (800) 942-0018 or (301) 987-9050.

Inquiry 1138.

Pacific Outlines I and II are font cartridges for your LaserJet III printer that Pacific Data Products claims are better than and cost one-third the price of Hewlett-Packard's outline fonts.

Together, the font cartridges contain 51 typefaces, which are selectable up to 999.75 points in quarter-point increments. They incorporate fast Intellifont font-scaling technology and are fully compatible with LaserJet III drivers used with the HP scaling-font cartridges.

Price: $299 each.

Contact: Pacific Data Products, Inc., 9125 Rehco Rd., San Diego, CA 92121, (619) 552-0880.

Inquiry 1139.

Turn One Parallel Port into Two

The Parallel Port Multiplexer is a tiny device that turns a single parallel port into two, complete with a 1K-byte TSR program to assign the ports to peripherals and a 6-inch cable.

Manufacturer Xircom designed the 3½-ounce device so that laptop users could simultaneously use a printer and its Pocket LAN adapters for Ethernet and Token Ring networking. But the Multiplexer is compatible with all parallel peripherals that need a DB-25 interface. The Parallel Port Multiplexer measures 2⅘ by 2½ by 1⅗ inches.

Price: $95.

Contact: Xircom, Inc., 22231 Mulholland Hwy., Suite 114, Woodland Hills, CA 91364, (818) 884-8755.

Inquiry 1137.

continued

INSTANT MAINFRAME. JUST ADD SCO.

Not too long ago, a few dozen people sharing the same programs, resources, and information on a single computer at the same time meant only one thing—a mainframe.

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Circle 259 on Reader Service Card

Arnet Offers Serial Boards with Surge Protection

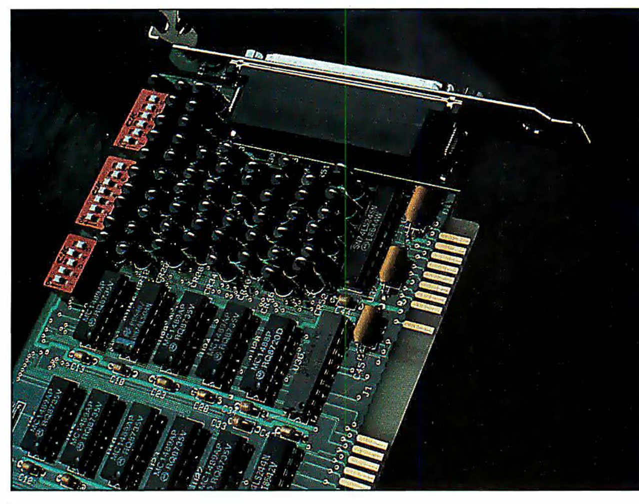
Serially networked PCs and peripherals now have more protection from power surges with Arnet's new serial-port expansion boards, the company says.

SurgeBlock protection is now part of five new boards. They include the Octaport, which features 64K bytes of dual-ported RAM, a 10-MHz 80C186 processor, an eight-port cable, and Simul-Print, a software driver that supports multiscreen sessions and lets users of terminals swap programs with a single keystroke while in other applications.

Smartport-8 is an eight-port board with 64K bytes of dual-ported RAM, 64K bytes of RAM (expandable to 512K bytes), a 16-MHz 80C186 processor, SimulPort (terminal paging software), and Simul-Print. You can expand Smart-port-8 to 16 or 24 ports.

Smartport-16 is a 16-port board that features all the functions of Smartport-8 and is expandable to 24 or 32 ports.

Price: Octaport, $1095; Smartports, $1595 to $2995.
Contact: Arnet Corp., 618 Grassmere Park Dr., Suite 6, Nashville, TN 37211, (800) 366-8844 or (615) 834-8000.
Inquiry 1140.



Arnet's Octaport is a serial-port expansion board that guards against energy spikes by bleeding off overvoltage before it can reach and damage chips.

System Sleuth on the Trail of Windows and the Mac

Dariana Technology Group has modified System Sleuth, its DOS program for analyzing and diagnosing a computer configuration, to work with Windows 3.0 and the Macintosh.

System WinSleuth is a Windows 3.0 program that ferrets out information about hardware and software configurations, attached peripherals, and memory. Dariana Technology says that everything from the DOS program has gone into WinSleuth, except where the use of protected mode will interfere. WinSleuth might not be able to find out as much information about areas like interrupts as System Sleuth does, the company concedes.

WinSleuth keeps track of how Windows is managing memory and informs you of the size of the largest remaining contiguous block of memory. This allows you to find out if there is still enough memory left to run Windows.

The program also tracks all the device drivers in the system and can report their capabilities.

System MacSleuth provides information about AppleTalk and the devices connected to a Mac via AppleTalk. It identifies the type of system, desk accessories, INITs, SCSI devices, slots, cdevs, and drivers.

Price: $149 each.
Contact: Dariana Technology Group, Inc., 7439 La Palma Ave., Suite 278, Buena Park, CA 90620, (714) 994-7400.
Inquiry 1141.

Learn to Enhance Your Group's Schedule

Advanced Concepts says that Office Minder 1.10, a groupware package, works on Novell, 3Com, Banyan, and compatible LANs. Enhancements include support for multiple file servers, wide-area networks, and remote communication with Message Handling System–compatible E-mail products.

Office Minder 1.10 includes a TSR program for E-mail, telephone messaging, group scheduling, project management, and resource management. Standard features are text editing, screen capture, and file attachments; ASCII import and export; shared to-do lists; appointment reminder alarms; and auto-dialing from embedded text. Office Minder runs in 2K bytes of RAM for simple mail notification, 56K bytes for messaging, and 86K bytes for a full-function system.

Price: $695 per server.
Contact: Advanced Concepts, Inc., 4129 North Port Washington Ave., Milwaukee, WI 53212, (800) 222-6736 or (414) 963-0999.
Inquiry 1142.

Forval's External Modem Speeds Data at 14,400 bps

The SA14400 is an external modem that transmits data without compression at 14,400 bps using an extended V.32 protocol for 14,400-bps data transmission. The CCITT standards body is bound to designate 14,400 transmission as V.32bis, the company says.

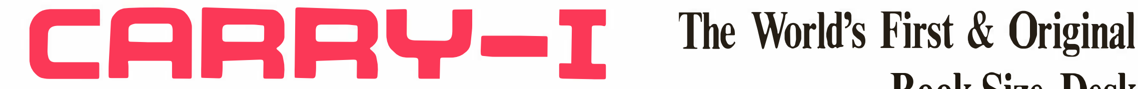
The SA14400 also includes the V.42bis compression algorithm that effectively quadruples data transfer rates and allows the modem to transmit at 57,600 bps. If it can't talk to a V.42bis modem, it defaults to the MNP-5 data-compression algorithm for 28,800-bps data transmission rates. And of course it's compatible with the standard V.32 rate of 9600 bps and the older data transmission protocols.

Because you can program the new modem's firmware via a data call over a standard phone line, you can receive updates that improve the modem's performance or add future standards by calling Forval using the modem itself, Forval says.

Some PC systems are no longer able to keep up with data transmissions at higher speeds and start to lose characters, so Forval's internal 14,400-bps modem uses a custom VLSI chip to buffer the data to the AT bus.

Price: Introductory price, $996; $1245 thereafter.
Contact: Forval America, Inc., Modem Division, 6985 Union Park Center, Suite 425, Midvale, UT 84047, (800) 367-8251 or (801) 561-8080.
Inquiry 1143.

continued



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82 Key/XT-AT Autoswitch

Dimension: 310mm × 145mm × 27mm Weight: 0.7kg

CARRY-I 80286

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FAX: 32-2-6460937

Circle 120 on Reader Service Card

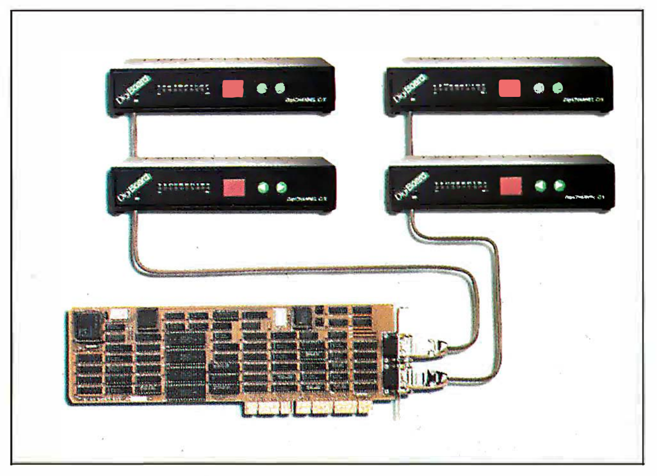
Share Your PS/2 with Unix and a C/X System

DigiBoard says that the DigiChannel MC C/X System now lets your PS/2 inexpensively support 16 Unix users through one add-in slot and a C/CON-16 concentrator box, a small peripheral. You can also expand the basic package to support 32, 48, and 64 users with more C/CON-16 concentrator boxes.

Two synchronous channels link the DigiChannel C/X adapter card with two concentrator boxes. You can daisy chain an additional concentrator box to each original concentrator to provide flexibility and allow for up to 64 concurrent users. Microprocessors on the DigiChannel C/X adapter card and the concentrator boxes work together to decrease the workload on the host CPU and to increase system throughput.

The C/X adapter card includes its own 10-MHz 80186, 128K bytes of RAM, and an 85C30 serial communications controller driving two full-duplex RS-422 synchronous channels.

Price: Basic package, $2195; separate C/CON-16, $1395.
Contact: DigiBoard, Inc., 6751 Oxford St., St. Louis Park, MN 55426, (612) 922-8055.
Inquiry 1144.



The DigiChannel MC C/X System, with one board and one C/CON-16 box, lets your PS/2 inexpensively support 16 Unix users; with four boxes, you can support 64 users.

Fax Server Alerts You to Received Faxes

NetFax is an add-in card and software you use with a dedicated PC to create a fax server for your NetWare network. It gives you the normal features of plain-paper printing when connected to a printer, plus remote faxing to or from any PC on the network.

What's unique about this new version of NetFax is its ability to alert you when it receives certain faxes, All The Fax says.

When you're waiting for a particular fax, you simply tell NetFax the Transmit Terminal Identification line (i.e., the header) that the sending fax transmits at the top of every page it sends. (Most fax machines have a setup utility that lets you automatically transmit the date, time, and company name—up to 20 characters—on the TTI line of each transmitted fax.) NetFax watches for that TTI line and sends you a "fax waiting" message through NetWare's message/broadcast facility when the fax comes in. Then you use DOS commands (NetFax uses no TSR program) to download the fax to your workstation from the fax server.

In practice, many companies don't use the TTI line for more than the time and date, and in those cases NetFax won't help you. But the company says that its TTI method is a less expensive routing method than using other companies' fax routing equipment designed for the telephone company service called Direct Inward Dialing.

You load about 50K bytes of NetFax software on the NetWare server, on the NetFax server, and on each workstation. For your NetFax server you must dedicate at least an XT with 640K bytes of RAM and a 20-MB hard disk drive.

Price: $995 per network.
Contact: All The Fax, Inc., 917 Northern Blvd., Great Neck, NY 11021, (800) 289-3329 or (516) 829-0556.
Inquiry 1145.

Disk and File Management

XTree Co. now offers two new versions of its disk and file management software for NetWare ELS and NetWare Advanced/SFT/386.

XTreeNet 2.0 gives administrators a visual display of their directory tree. There they can manipulate the files to access, edit, view, delete, rename, list, print, or copy any combination of files anywhere on the network. XTreeNet 2.0 is designed to help users eliminate duplicate files, access the most recent copy of any document, and move or copy files to local storage devices.

Peer-to-peer capabilities allow you to view, copy, delete, and edit files on distant workstations from designated workstations (rather than from the file server). With the Autoview feature, you can split the screen and browse through multiple files on the left while displaying their contents on the right. And each copy of XTreeNet 2.0 comes with file viewers that enable you to see formatted views of files in Lotus 1-2-3, dBASE, XyWrite, Microsoft Word, WordPerfect, Multimate, Paradox, and other popular programs.

System requirements are DOS 3.1, 256K bytes of RAM, and NetWare ELS or Advanced/SFT/386.

Price: NetWare ELS, $249; NetWare Advanced/SFT/386, $495.
Contact: XTree Co., 4330 Santa Fe Rd., San Luis Obispo, CA 93401, (800) 634-5545 or (805) 541-0604; in California, (800) 551-5353; in Canada, (416) 866-8592.
Inquiry 1147.

UPSes for NetWare Broadcast Alerts of Power Failures

The MPS 1200 and 1500 are uninterruptible power supplies (providing on-line power rather than backup power) for your Novell LAN. They supply 1200 VA and 1500 VA of on-line power, respectively.

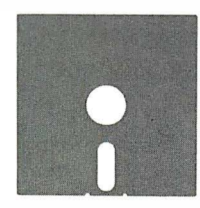
Network Monitor, the associated software, alerts all LAN users of impending power failures. It works as a value-added process on a file server running NetWare.

Price: MPS 1200, $1699; MPS 1500, $2199.
Contact: Unison Technologies, Inc., 23456 Madero, Mission Viejo, CA 92691, (714) 855-8700.
Inquiry 1146.

continued

Whether you're protecting frontiers and temples in Manchuria, or software and data on the PC or Mac, the Great Wall is a lesson Rainbow Technologies has learned very well.

Software developers must deal daily with the consequences of unauthorized copies and millions of dollars in lost revenue. At the same time, both individual and corporate users must be able to make and distribute copies within legal guidelines.



Today's information-driven companies must secure their data files against theft and unauthorized access. No less than protecting personal wealth and tangible property, guarding data files is a necessary investment in competitive survival.

Protecting "intellectual property" is the security challenge for the '90s. Which is why Rainbow Technologies builds a little of the Great Wall into every key it makes.

For developers, the Software Sentinel™ family of keys protects IBM, PS/2 and compatible software, while Eve™ guards software for the Mac. Rainbow's DataSentry™ is the solution for PC data protection.

Times Change. The Need To Protect Doesn't.



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Software and data protection from Rainbow Technologies. Information on how you can have a little piece of the Great Wall to protect your software and data worldwide is as close as a toll-free call.



How to plan your LAN.

You'll need a pencil.

That's to write down the telephone number on the next page. Which will connect you with Samsung's nationwide network of resellers. And the Samsung/Novell co-labeled line of LAN hardware.

It's pretty much that simple.

With one call you can plan on substantial savings over the big name computers which, despite high clock rates and even higher price tags, are not really optimized for networking.

And you can plan on 100 percent compatibility with all versions of Novell's NetWare,* because Samsung's LAN hardware was co-designed by Novell. Just like the label says.

THE TESTING WENT IN BEFORE THE LABEL WENT ON.

Both the Samsung 386AE and PCterminal/286 have been tested exhaustively and certified by Novell for compatibility with all popular networking hardware and software products. As a matter of fact, Samsung's 386AE is one of 3 fileservers certified by Novell to run NetWare 386.

For example, engineers at Novell successfully tested the PCterminal/286 LAN Workstation in no less than 1200 different network configurations... with 50 units running at once! That's a claim no other computer manufacturer can make.

NETWORKING VS. NOTWORKING.

What's the difference? Take our 386AE Fileserver, for instance. It includes Novell's Advanced BIOS, and eight expansion slots to accommodate multiple network interface cards and disk controllers. Plus an oversize power supply capable of driving dual high capacity hard disks and tape

back-up system. Plus 4 megabytes of main memory for disk caching.

Then there's Samsung's PCterminal/286 Diskless Workstation which includes a built-in Ethernet interface and Novell's Remote Boot EPROM.

And not to be overlooked is our 16-bit SE2100 Ethernet Interface Card which provides up to twice the throughput for the price of an 8-bit card.

THE SAMSUNG COMMITMENT.

With 4 million monitors and half a million PC and LAN computers sold in 1988 alone, it's clear that Samsung has made a serious commitment to the marketplace. In all, Samsung offers no less than nine different PC and LAN computer models with seventeen color and monochrome monitors! And, as a 31-billion dollar international corporation, Samsung has the resources to provide continuous support for its customers.

So why not begin your network planning today? For the name of the Samsung reseller nearest you, write:
SAMSUNG, 3655 North First Street, San Jose, CA 95134, or call **1-800-446-0262.**





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MetaWindow Puts TV in Your Computer Screen

With the MetaWindow graphics toolkit, you can develop applications that let an end user work in one application while viewing live video that appears in a resizable, movable window. A program that lets stockbrokers view a live feed from Financial News Network while using another program to buy and sell stocks is one possible MetaWindow application.

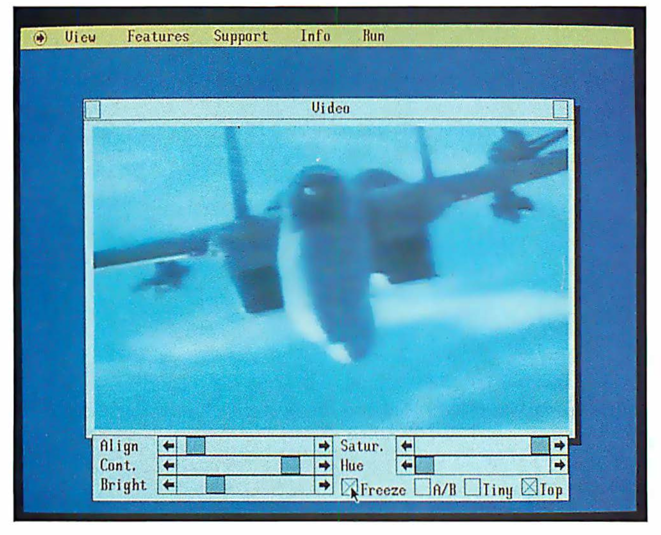
MetaWindow applications can run on DOS, Unix, OS/2, and Windows systems that include a New Media Graphics VideoWindows digital video card. The card supports live or taped video.

A program written in C or Pascal can call the more than 250 routines of the object module library.

Price: $250.

Contact: Metagraphics Software Corp., 4575 Scotts Valley Dr., P.O. Box 66779, Scotts Valley, CA 95066, (408) 438-1550.

Inquiry 1148.



Applications created with the MetaWindow graphics toolkit let you watch full-motion images from a standard American or European video source.

Two Parallel Programming Environments

Top Level Common Lisp (TopCL) 2.0, for developing Unix System V– and X Window System–based multiprocessing programs, relieves you of the programming hassles of synchronicity through its use of future objects.

Top Level describes a future object as a promissory note or blank check. Once you specify a fork, the system immediately returns a future object, the value of which is undetermined until a computation is complete.

TopCL reduces the number of function calls required to fork a computation, allowing you to fork small computations efficiently, with little overhead.

The program includes Meta Debug, an external debugger, and a foreign function interface for calling existing software.

TopCL runs on PCs and workstations based on the Intel 80x86 and i860, Motorola 88000, and National Semiconductor 32x32 chips. The company also plans to release a version for OS/2.

Price: $3300 for a system for a two-processor PC.

Contact: Top Level, Inc., 196 North Pleasant St., Amherst, MA 01002, (413) 256-6405.

Inquiry 1149.

An Abstract Machine in the Strand 88 parallel programming language encapsulates hardware-dependent features so that applications can run across all platforms that Strand Software supports.

Strand's foreign function interface supports sequential C and FORTRAN applications.

Strand 88 Buckingham, the newest version, includes a profiler, a task scheduler, and a resolvent analysis tool. It also runs 50 percent faster than the previous version.

Strand runs on PC-based transputer systems, multiprocessor machines, and workstations running on Unix/V 386.

Price: $1500 and up.

Contact: Strand Software Technologies, Inc., 15220 Northwest Greenbrier Pkwy., Suite 350, Beaverton, OR 97006, (503) 690-9830.

Inquiry 1150.

New Linker Gives DOS Programs Virtual Memory

The Virtual Memory Linking feature of the .RTLink/Plus 4.0 linker gives DOS applications virtual memory capabilities similar to those of OS/2 and Windows without requiring a hardware upgrade. With VML, DOS programs execute in conventional memory and up to 32 MB of expanded memory.

In most situations, one command during link time adds VML capability to a program without requiring source code changes or the programming analysis of overlays. The linker manages available memory and discards infrequently accessed pages when more memory is needed to bring in a page.

Instead of bringing pages into memory through a reference to a piece of data, the VML feature does it through calls or jumps to code symbols.

The VML feature of the linker initially supports Microsoft C, while the linker itself is compatible with all DOS programming languages. Pocket Soft will continue to add VML support for other programming languages.

Price: $495.

Contact: Pocket Soft, Inc., 7676 Hillmont, Suite 195, Houston, TX 77040, (713) 460-5600.

Inquiry 1151.

Develop SQL Applications in Windows

With two products from Coromandel, you can build and run transaction-based or Structured Query Language–based data management applications under Windows 3.0.

Integra SQL offers a high-level programming interface based on embedded SQL statements and a low-level interface for directly manipulating tables and performing record operations. It automatically handles data management, query optimization, and data integrity, the company says.

C-Trieve/Windows is a library of routines for building transaction-based applications.

Price: Integra SQL, $695; C-Trieve/Windows, $395.

Contact: Coromandel Industries, 108–27 64th Rd., Forest Hills, NY 11375, (718) 997-0699.

Inquiry 1152.

continued



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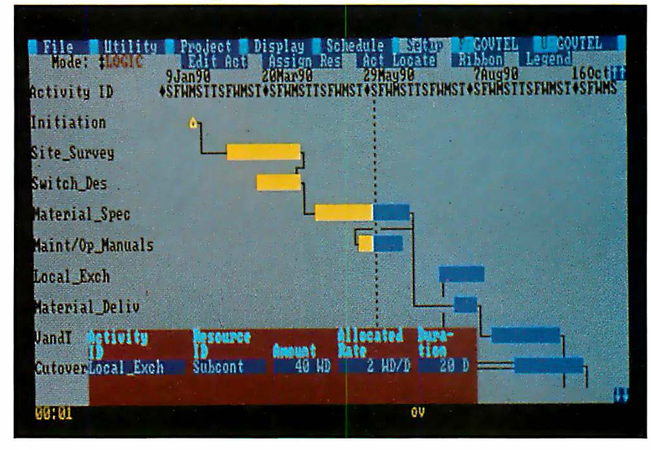
Sketch Out Projects with Qwiknet

Project Software & Development has added a graphical user interface to Qwiknet Professional 2.0, a multiproject management program for in-depth scheduling and cost analysis on the IBM PC.

The program's drawing-board feature lets you sketch out a project, instead of requiring that you build critical-path method schedules with tabular forms and advanced constructs. A windowing system lets you navigate through screens, and a pick-and-drop function lets you copy information from one field, screen, or file to another without typing.

Version 2.0 lets you define an activity's duration as a function of its resource allocation where appropriate. What-if analysis and the ability to schedule up to 250 projects with a common resource pool, so that all resources are used without being double-booked, are included in the program.

Price: $2500; $8600 per four-concurrent-users package.
Contact: Project Software & Development, Inc., 20 University Rd., Cambridge, MA 02138, (617) 661-1444.
Inquiry 1153.



Qwiknet's new drawing-board interface for managing projects. Tasks and portions of tasks in yellow are complete, while those in blue haven't been finished.

A Database/Spreadsheet Companion

Feldstar says that Analyst 1 combines the calculation ability of spreadsheets with the historical tracking of databases so that you can develop and maintain analyses over extended periods of time in a single model. The program doesn't replace a DBMS or spreadsheet, but it lets you identify and graph trends from historical data.

With the program's relational database capabilities, you can track the performance of your sales staff by various products and multiple time periods that you choose. You compare these relationships using reports and line, bar, pie, and wave charts.

You can export data from a spreadsheet to Analyst 1 by printing the spreadsheet to a file unformatted. You then insert a date into the first column so that Analyst can use it.

Analyst 1 runs on the IBM PC with 512K bytes of RAM.

Price: $199.
Contact: Feldstar Software, Inc., P.O. Box 871564, Dallas, TX 75287, (214) 407-1006.
Inquiry 1154.

Softview's Intelligent Business Forms Package

Softview, developer of the MacInTax tax preparation program for the Mac and IBM PC running Windows, has released a forms-design program with an underlying technology that lets you create and modify forms without having to start from scratch.

The if:X Forms Designer lets you make last-minute changes, such as adding a company logo or resizing a form, without requiring you to rearrange its elements. The program can insert, copy, and move pieces of a form with a single command. As you design the form, you can transpose columns and exchange noncontiguous elements.

When you transfer data from the if:X Forms Designer to another application, such as Excel, through the Clipboard, text retains its font style and style information. Tabular data exchanged either way retains its structure.

The if:X Forms Designer runs on the Mac Plus with 1 MB of memory. The current version of the program doesn't have the calculating capabilities present in MacInTax, but that feature will be added in the next version, scheduled to ship next year.

Price: $279.
Contact: Softview, 1721 Pacific Ave., Suite 100, Oxnard, CA 93033, (800) 525-1065 or (805) 385-5000.
Inquiry 1155.

Date Sensitivity Added to Accounting Package

Cyma's new versions of its Professional Accounting Series 2.0 for Unix, Xenix, and AIX running on the IBM RISC System/6000 let you create entries or generate reports for previous or future periods without disturbing current period data, which removes the pressure of period closings. PAS 2.0, which is also available for DOS, includes a report generator and a macro feature.

You can run the program's seven modules separately or integrated with other modules: general ledger, accounts payable, accounts receivable, payroll, inventory and order processing, job control, and system manager.

Price: $495 to $1195 per module.
Contact: Cyma, 1400 East Southern Ave., Tempe, AZ 85282, (800) 292-2962 or (602) 831-2607.
Inquiry 1156.

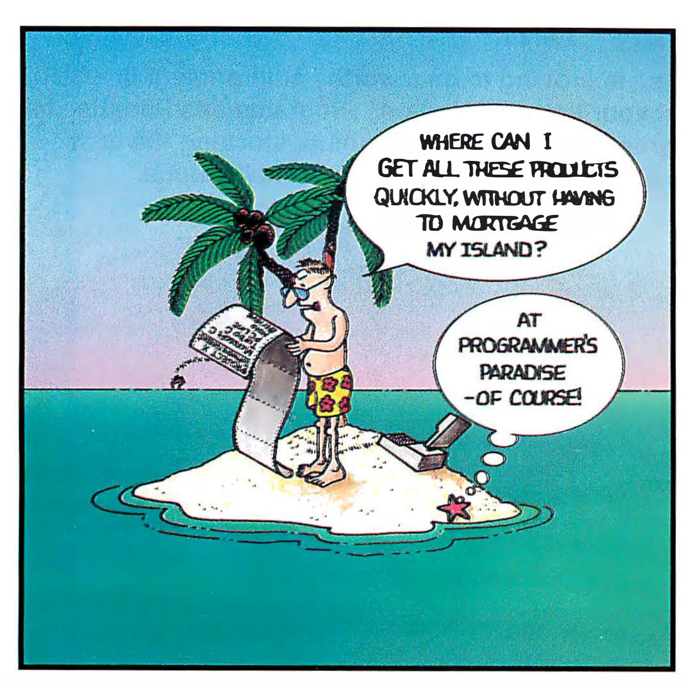
Intex Breaks the 640K-byte Barrier for 1-2-3 release 2.0

With Beyond 640 for 1-2-3, users of Lotus 1-2-3 release 2.0 can exploit expanded memory, accessing up to 4 MB of memory for their spreadsheets, Intex reports. The program monitors your memory use, and as you approach the conventional memory limit, Beyond 640 kicks in and lets 1-2-3 store its entire spreadsheet in expanded memory, making the Memory Full error message obsolete. The program works with 1-2-3 releases 2.01 and 2.2, and EMS 3.2 or 4.0.

Price: $95.
Contact: Intex Solutions, Inc., 161 Highland Ave., Needham, MA 02194, (617) 449-6222.
Inquiry 1157.

continued

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Microsoft Windows 3.0	150	99
VM/386	245	209
VM/386 MultiUser	895	839
VM/386 MultiUser Starter	395	339
386 DEVELOPMENT TOOLS		
386 ASM/LinkLoc	1295	1145
Lahey F77L-EM/32 (w/ OS/386)	1290	1035
MetaWare High C 386	895	849
Novell C Network Compiler/386	995	799
Paradox/386	895	629
PC-lint 386	239	179
Phar Lap 386 ASM/LINK	495	435
WATCOM C 8.0/386 Prof.	1295	1099
WATCOM C 8.0/386 Standard	895	719
ASSEMBLY LANGUAGE		
Advantage Disassembler	295	279
ASMFlow	99	89
MS Macro Assembler	150	105
OPTASM	150	129
Re:Source	150	129
Sourcer w/ Pre-Processor	170	149
SpontaneousAssembly	395	359
Turbo Debugger & Tools	150	99
Visible Computer: 80286	100	89
BASIC COMPILERS		
MS BASIC Prof. Devel. System	495	349
Power Basic	129	89
QuickBASIC	99	69
True BASIC	100	69
BASIC LIBS/UTILITIES		
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DiaLogic	95	85
GraphPak	79	70
GraphPak Professional	149	129
P.D.Q.	129	115
ProBas	159	149
ProBas Toolkit	99	94
ProMath	99	94
QBase and Quickscreen	149	125
QuickComm	149	119
QuickPak	79	70
QuickPak Professional	169	149
QuickPak Scientific	79	70
QuickScreen	99	90
QuickWindows Advanced	149	119
C COMPILERS		
C Network Compiler	695	559
Lattice C 6.0	250	155
Lattice C 286 (w/ extension)	495	395
Microsoft C 6.0	495	339
MS QuickC 2.5	99	69
MS QuickC w/QuickAssembler	199	139
Top Speed C Standard	199	155
Extended Edition	395	315
OS/2 Professional	495	445
Turbo C 2.0	99	69
WATCOM C 8.0 Professional	495	419
WATCOM C 8.0 Standard	395	335

	LIST	OURS
C++		
C++/Views	495	419
NDP C++	495	479
Turbo C++	200	CALL
Turbo C++ Professional	300	CALL
Zortech C++ Debugger	150	129
Zortech C++	200	165
Developer's Edition	450	399
Zortech C++ Tools	150	129
Zortech C++ Video Course	500	449
C-COMMUNICATIONS		
Breakout II	249	189
C Asynch Manager 3.0	189	139
Essential Communications	329	259
Greenleaf CommLib	359	287
Greenleaf ViewComm	399	319
SilverComm C Asynch Library	249	209
View-232	189	149
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AccSys for dBASE or Paradox	395	349
Btrieve Devel. System	595	449
C-ISAM	225	209
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CQL w/PASS	395	349
c-tree	395	315
dBC III	250	229
dBC III Plus	500	439
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Essential B-Tree w/source	198	149
FairCom Toolbox - Prof. Edition	1095	789
FairCom Toolbox - Special	695	509
Informix Products	CALL	CALL
Paradox Engine	495	349
Xtrieve PLUS	595	459
C-GENERAL LIBRARIES		
Blackstar C Function Library	99	79
C TOOLS PLUS/6.0	149	109
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Greenleaf Functions	229	179
Greenleaf SuperFunctions	299	239
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C SCREENS		
Greenleaf DataWindows	395	315
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QuickWindows Advanced (C)	169	149
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Vitamin C	225	165
VC Screen	149	125
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C Shroud	198	149
C-Terp	300	219
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Heap Expander	80	70
PC-lint	139	105
PCYACC Professional	495	459
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TimeSlicer	295	279

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Micro Focus:		
COBOL/2 w/ Toolset	1800	1499
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MS COBOL	900	629
Realia COBOL	995	849
SCREENIO	400	375
CODE GENERATORS		
Logic Gem	99	69
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PRO-C	399	339
DATABASE DEVELOPMENT		
Clarion 2.1	CALL	CALL
Clipper 5.0	795	519
Data Junction Advanced	299	269
dBASE IV	795	489
dBFast/PLUS	345	295
dGE	295	249
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R&R Code Generator	150	129
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SilverComm Library 2.0	249	209
Tom Rettig's Library	100	80
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OPTDEBUG	150	129
Periscope I/512K	595	475
Periscope II	175	125
Periscope II-x	145	105
Periscope IV/16, 25 MHz	CALL	CALL
Turbo Debugger & Tools	150	99
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C-Clearly	130	115
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Paginate	100	79
Source Print	99	74
The Documentor	295	245
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EDT+	295	269
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Epsilon	195	159
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Multi-Edit Professional	179	159
Norton Editor	75	59
SLICK Editor	195	154
Sage Professional Editor	295	249
w/Mouse	395	319
SPF/PC	245	199
VEDIT PLUS	185	CALL
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Link & Locate ++ Extended	479	395
Paradigm Locate	295	265
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Grafmatic	135	119
Lahey F77L	595	535
Lahey Personal FORTRAN 77	99	89
MS FORTRAN	450	299
Plotmatic	135	119
RM/FORTRAN	595	499
WATCOM FORTRAN 77/386	1095	CALL
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Baby Driver	250	199
Essential Graphics	399	319
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Font Window	125	109
Graf/Drive Plus Developer's	299	269
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Graphics-MENU	179	159
Data Entry	99	89
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MetaWindow	250	209
MetaWindow Plus	325	289
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PCX Text	149	135
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Plink86plus	495	395
Plink/LTO	695	619
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.RTLink	295	265
.RTLink/Plus	495	419
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CASE:PM for C	1495	1420
Epsilon	195	159
MS OS/2 Pres. Manager Softset	150	105
MS OS/2 Pres. Manager Toolkit	500	349
MultiScope for OS/2	449	345
PCYACC	695	625
Repository Explorer	995	895
Smalltalk/V PM	495	369
TopSpeed Modula-2 (OS/2)	495	449
Vitamin C (OS/2)	345	279
Zortech OS/2 Compiler Upgrade	150	129
PASCAL LANGUAGE		
Asynch PLUS	149	115
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Object Professional	150	109
Power Tools PLUS/5.0	149	109
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Turbo Analyst	99	89
TurboMAGIC	199	179
Turbo Pascal 5.5	150	105
Turbo Pascal 5.5 Professional	250	175
Turbo-Plus 5.5	199	159
Turbo Professional 5.0	125	109
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Smalltalk/V	100	85
Smalltalk/V 286	200	169
Smalltalk/V PM	495	395
SOURCE MAINTENANCE		
MKS Make	149	119
MKS RCS	189	149
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PolyMake	149	125
PVCS Professional	495	419
SMS	495	399
TLIB	139	109
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Asymetrix Toolbook	395	CALL
Bridge Toolkit	695	659
Case:W	795	759
C-Talk/Views	450	375
dBFast/Windows	395	335
DialogCoder	499	435
MS Windows Development Kit	500	349
MultiScope for Windows	379	289
Object Graphics	395	319
ProtoView	695	625
RFFlow	79	69
Whitewater Resource Toolkit	195	169
WindowsMAKER	595	535
WinTrieve	395	339
WNDX GUI Toolbox	499	449

NEW RELEASES

GUIDO *by South Mountain*

Graphical user interface library for C. Includes pull-down, pop-up, vertical and horizontal menus, windows, text and list boxes. Create high-level objects.

List: $249 **Ours: $199**

w/source List: $499 **Ours: $399**

C Shroud *by Gimpel*

Source code obfuscation tool. Translates a program from its original C source into an encoded format that can be compiled but not readily understood by humans. Distribute to a wide variety of computer equipment without risking your investment in proprietory software.

List: $198 **Ours: $ 149**

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Recently purchased by Abraxas, Microport products are again available–including Microport System V/386, Release 3 multi-tasking, multi-user UNIX, and DOS Merge which allows two operating systems, DOS and UNIX to operate on one computer.

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LPI-FORTRAN	995	799
MetaWare High C	895	849
Microport Complete-286 (unltd.)	899	809
Microport Complete-386 (unltd.)	1198	1079
Microport–Other Products	CALL	CALL
MKS RCS	395	335
MKS Trilogy	119	105
SCO 286 Complete	1495	1195
SCO 386 Complete	1595	1275
SCO (All other products)	CALL	CALL
VEDIT PLUS	285	249

ADDITIONAL PRODUCTS

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APL*PLUS	695	549
Dan Bricklin's Demo II	199	159
IntegrAda	795	719
Janus Ada/Compiler System	360	319
Lattice RPG	1600	1285
Meridian AdaStudent	50	45
Meridian Ada Developer's Kit	1195	1095
MKS AWK	99	79
Personal Rexx	150	139

APPLICATION SOFTWARE

COMMUNICATIONS

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BLAST II	250	239
Carbon Copy Plus	199	129
Laplink III	150	99
PC Anywhere III	145	99
Procomm Plus	99	63
SideTalk	120	99

DESKTOP PUBLISHING

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Adobe Products	CALL	CALL
Corel Draw!	595	399
Gem Desktop Publisher	299	169
HALO DPE	195	139
Lattice HighStyle	375	319
MKS SQPS	495	479
PageMaker	795	509
Ventura Publisher	895	549

MATHEMATICS

	LIST	OURS
Derive	200	179
MathCAD	495	315
Mathematica 386	695	625

SCIENCE & ENGINEERING

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AutoCAD Release 10	3000	CALL
AutoSketch	150	95
ChiWriter	150	129
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DADiSP	895	759
Design CAD 3-D	400	292
Drafix Windows CAD	695	CALL
EXACT	475	380

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Generic CADD Level 3	350	289
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LABTECH Notebook	995	779
MICRO-CAP III	1495	1269
Orcad PCB	1495	CALL
PC TEX	249	229
SCHEMA III	495	449
STATGRAPHICS	895	586
Systat	595	449
Tango PCB Series II	595	559
TECH*GRAPH*PAD	395	319
T³	595	479

SPREADSHEETS

	LIST	OURS
Lotus 1-2-3 Release 3.0	595	389
Microsoft Excel	495	319
Quattro Professional	495	329
SuperCalc5	495	319

UTILITIES

	LIST	OURS
386 MAX Professional	129	114
above DISC	119	64
Dr. Switch DeveloperPak	99	89
FASTBACK Plus	189	109
HeadRoom 2.0	130	109
Help Build	249	179
Hold Everything	199	159
MACE 1990	149	129
Magellan	195	CALL
Memory Mate	70	47
MKS Toolkit	249	199
Move'em	89	79
Norton Commander	149	99
Norton Utilities	100	65
Norton Utilities Advanced	150	99
PC Tools Deluxe	149	95
Pizazz Plus	149	79
SitBack	99	90
Software Carousel	90	72
SpinRite II	89	75
XTreePro Gold	129	109

WORD PROCESSING

	LIST	OURS
Ami	199	129
Microsoft Word for Windows	495	349
WordPerfect 5.1	495	CALL

SOFTWARE FOR SUN WORKSTATIONS

	LIST	OURS
Basmark QuickBASIC	CALL	CALL
C Programmer's Toolbox/ Sun	495	449
Edix	425	339
EMACS for Sun	395	369
Eroff	CALL	CALL
Informix	CALL	CALL
Lotus 1-2-3 for Sun	695	CALL
Lotus 1-2-3 for Sun Server	995	CALL
Lotus 1-2-3 for Sun Node	495	CALL
Mathematica for Sun	CALL	CALL
MetaWare High C	895	849
NeuralWorks Professional II	4095	CALL
Panel Plus (Sun 3)	1595	1355
WordPerfect for Sun	495	CALL

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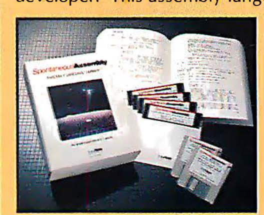
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SpontaneousAssembly

SpontaneousAssembly is a must-have product for the serious software developer. This assembly language library lets you produce the fastest, tightest possible programs with the same ease you'd expect from a high-level language. It includes an impressive collection of over 700 functions and macros for high-speed text windowing, heap management, array searching and sorting, critical error management, 32/64 bit integer math, and much more! Comprehensive 750+ page manual. Full source code. No royalties. Easy integration with C.



"If you program in assembly language, you gotta have SpontaneousAssembly."
- Michael Abrash

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List: $ 139 Ours: $109 **FAXcetera #1611-0001**

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List: $199 Ours: CALL **FAXcetera #1271-0001**

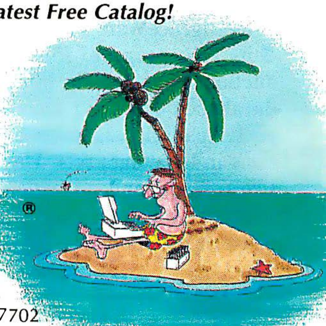
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Graphically Programmed Motion Control on the Mac

National Instruments and nuLogic have teamed up to provide an environment for developing motion-control programs for the Mac without requiring you to write a single line of code.

The system combines nuLogic's three-axis servo motion-control card for NuBus-based Macs and its interface for LabView 2, the graphical programming environment for data acquisition, analysis, and instrument control. With the system, you can program applications for robotics control, machines, and production automation systems by placing and connecting icons that represent controls such as knobs, slides, and switches.

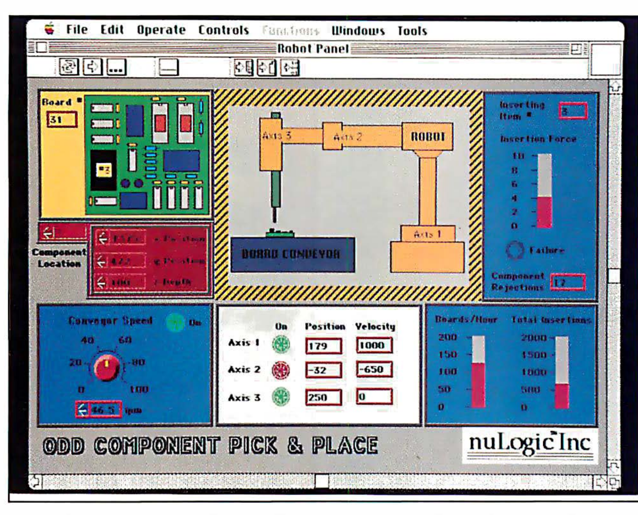
The number of machines a system can control depends on how many slots your Mac has and how many axes must be controlled for each machine. With two controller cards, you can control three two-axis machines, for example.

You need a Mac II with LabView 2, the controller card, and the Virtual Instrument Library for Motion Control.

Price: LabView 2, $1995; VI Library, $195; nuControl controller card, $1795.

Contact: nuLogic, Inc., 945 Great Plains Ave., Needham, MA 02192, (617) 444-7680.

Inquiry 1158.



As LabView 2 controls a pick-and-place machine for odd-shaped components, it displays at right information on insertion force, number of boards completed per hour, and total insertions while letting you control the conveyor speed in the lower left window.

Solve Heat-Transfer Problems with Your PC or Mac

Whether your field of engineering is mechanical, electrical, chemical, or civil, you'll likely encounter a heat-transfer problem that requires several hours or days to solve. A program called Heat Transfer on TK can reduce the time it takes to solve such problems by a factor of 100, according to Universal Technical Systems.

The menu-driven program is based on, and ships with, the textbook *Fundamentals of Heat and Mass Transfer* and 200 heat-transfer models. Once you find the correct model and insert the real-life numbers, the program's equation solver returns the solution.

The program is available for the IBM PC, the Macintosh, and Sun, IBM, Hewlett-Packard, and Apollo Unix workstations. TK Solver Plus is required.

Price: Heat Transfer on TK, $595; TK Solver Plus, $395.

Contact: Universal Technical Systems, Inc., 1220 Rock St., Rockford, IL 61101, (800) 435-7887 or (815) 963-2220.

Inquiry 1159.

Analyze and Manipulate Signals on the Mac

BV Engineering's Signal Processing Program (SPP) can perform linear and nonlinear time-domain waveform analysis, forward and reverse fast Fourier transforms, and other analyses on analog signals. It can graphically display signals, spectra, and transfer function data, and it can generate and simulate analog signals.

SPP runs on the Mac 512KE or higher with Finder 5.3 and System 3.2 or higher.

Price: $349.95.

Contact: BV Engineering, 2023 Chicago Ave., Suite B13, Riverside, CA 92507, (714) 781-0252.

Inquiry 1160.

Acquire Data While You Do Something Else

Trilobyte has released a product for engineers and scientists who need to acquire data from lengthy experiments but don't want to tie up their PCs.

Data Demon lets you receive data from instruments while you perform other tasks. The program can hold up to 32K bytes of received data in one buffer.

A memory-resident portion of the program performs the actual data collection, while another portion downloads the information.

Price: $99.

Contact: Trilobyte, Inc., 596 Abolicion, Hato Rey, Puerto Rico 00918, (809) 758-0341 or (809) 767-1839.

Inquiry 1161.

continued

Find the Hidden Information with IXL

IntelligenceWare says that its IXL program for induction in extremely large databases can find unexpected patterns and correlations in large data sets. Unlike a query language, which requires you to formulate and test a hypothesis, IXL forms its own queries and automatically tests for them.

By combining AI, statistics, and database capabilities, the program saves you from having to test numerous hypotheses when you're trying to pinpoint the reasons for problems like sporadic defects on an assembly line. The program has uses in any application involving large data sets.

The program supports up to 64,000 columns per database and runs on the IBM AT or higher. The program is compatible with dBASE, Lotus 1-2-3, XDB, and Interbase file formats.

Price: $490.

Contact: IntelligenceWare, Inc., 9800 South Sepulveda Blvd., Suite 730, Los Angeles, CA 90045, (213) 417-8896.

Inquiry 1162.

PC-Write Lite Supports Cyrillic Characters

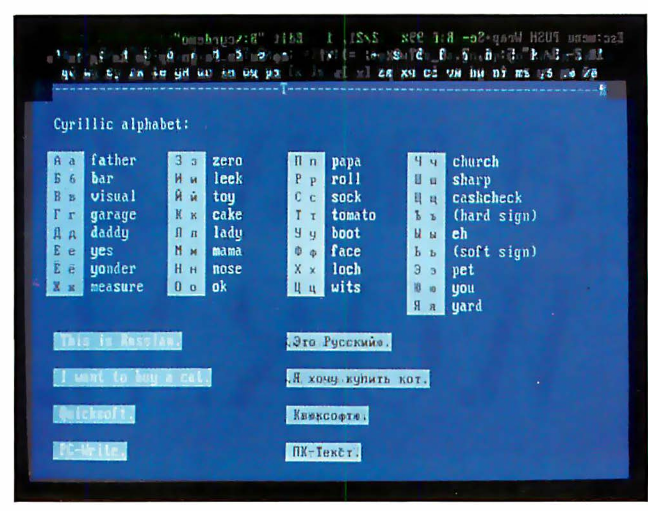
The new version of PC-Write Lite supports the Cyrillic character set for creating documents in Slavic languages such as Russian.

You use the Caps Lock key to switch from Roman to Cyrillic characters. If you have an EGA or VGA graphics adapter, you can see the Cyrillic characters on the screen as you type. If you don't have such an adapter, you need to change your adapter card's character-set ROM to support those characters. Otherwise, with a non-EGA or -VGA screen, you can print Cyrillic hard copy, but you'll see the IBM extended character set on the screen as you type.

Version 1.02 also lets you create new character sets to support Greek and Hebrew, chemistry formulas, phonetics, and anything else with symbols. A Russian spelling checker is available to add complete Russian language support.

The program requires 384K bytes of RAM with the spelling checker, 256K bytes without it.

Price: $79; spelling checker, $29.
Contact: Quicksoft, 219 First Ave. N, Suite 224, Seattle, WA 98109, (206) 282-0452.
Inquiry 1163.



By using the Caps Lock key on a VGA or EGA screen, PC-Write Lite lets you switch between English and Cyrillic characters. If you type in the wrong alphabet, you can switch each word or an entire document to the correct alphabet.

A Menuing Program for Unix

A program called MenuMagic lets even novice Unix users handle up to 98 percent of the day-to-day system administration tasks, such as maintaining printers and spoolers, putting users on the system, and backing up files.

The program also includes a developer's toolkit for creating custom functions.

MenuMagic supports the major flavors of Unix, including AT&T, SCO, Intel, Interactive, and IBM AIX. A version for the X Window System will be released later this year.

Price: $495; Xenix version, $345.
Contact: TKi, P.O. Box 2049, Roswell, GA 30077, (404) 640-1515.
Inquiry 1164.

Two Programs for Unattended Computing

If you're tired of performing mundane operations such as database sorts, mail merges, and system backups, Auto-Run can help by letting your PC run a variety of everyday tasks at any time of the day or night.

When you decide which operations to automate, you use Auto-Run's Memorize command, which lets the program watch and learn the keystrokes. You then tell it at what time and on which days to run the task. You can use the program to send and receive data, update a spreadsheet, and perform many other operations.

Version 2.0 provides password protection. You can set up a task to prompt you for a specific action during an Auto-Run session, and you can also tell Auto-Run what to do if it gets an error message.

Auto-Run is not a TSR program. It requires 36K bytes of RAM on the IBM PC.

Price: $149.
Contact: AutoSoft, Inc., 1850 Lake Park Dr., Suite 105, Smyrna, GA 30080, (800) 252-7144 or (404) 436-7144.
Inquiry 1165.

You can instruct Automate/Anytime to process batch files, generate reports, and perform system backups. When backing up, the program can compress files to as little as 15 percent of their original size.

At the prescribed time, Automate/Anytime interrupts the current operation, performs its task, and brings you back to the initial operation. The program supports unattended operation.

Automate/Anytime is a TSR program that requires 20K bytes of RAM.

Price: $149.
Contact: Complementary Solutions, Inc., Suite 202, 4470 Chamblee-Dunwoody Rd., Atlanta, GA 30338, (404) 454-8033.
Inquiry 1166.

Word Tool Knows Politics + Delay = Filibuster

Microlytics has developed a new word utility that can function like a dictionary in reverse. Instead of requiring you to look up a particular word's meaning, Inside Information lets you type in a few words of description. You can ask, "What's the word for...," and Inside Information returns a list of appropriate candidates.

Beneath the program's seven general classes (e.g., nature, science, and technology) lie subclasses, categories, and subcategories.

Inside Information holds over 65,000 words, most of which are defined. In addition to the reverse dictionary, you can search for words directly or by descending a hierarchical tree structure.

The program uses several indexing techniques, including "word nerding," developed by Xerox. This technique associates dissimilar words with similar meanings (e.g., "AIDS" and "HIV+") and links them.

The program is currently available for the Mac and IBM PC. A version for Windows will ship by the end of the year. Versions for each platform are binary compatible, allowing you to put the program on a network server.

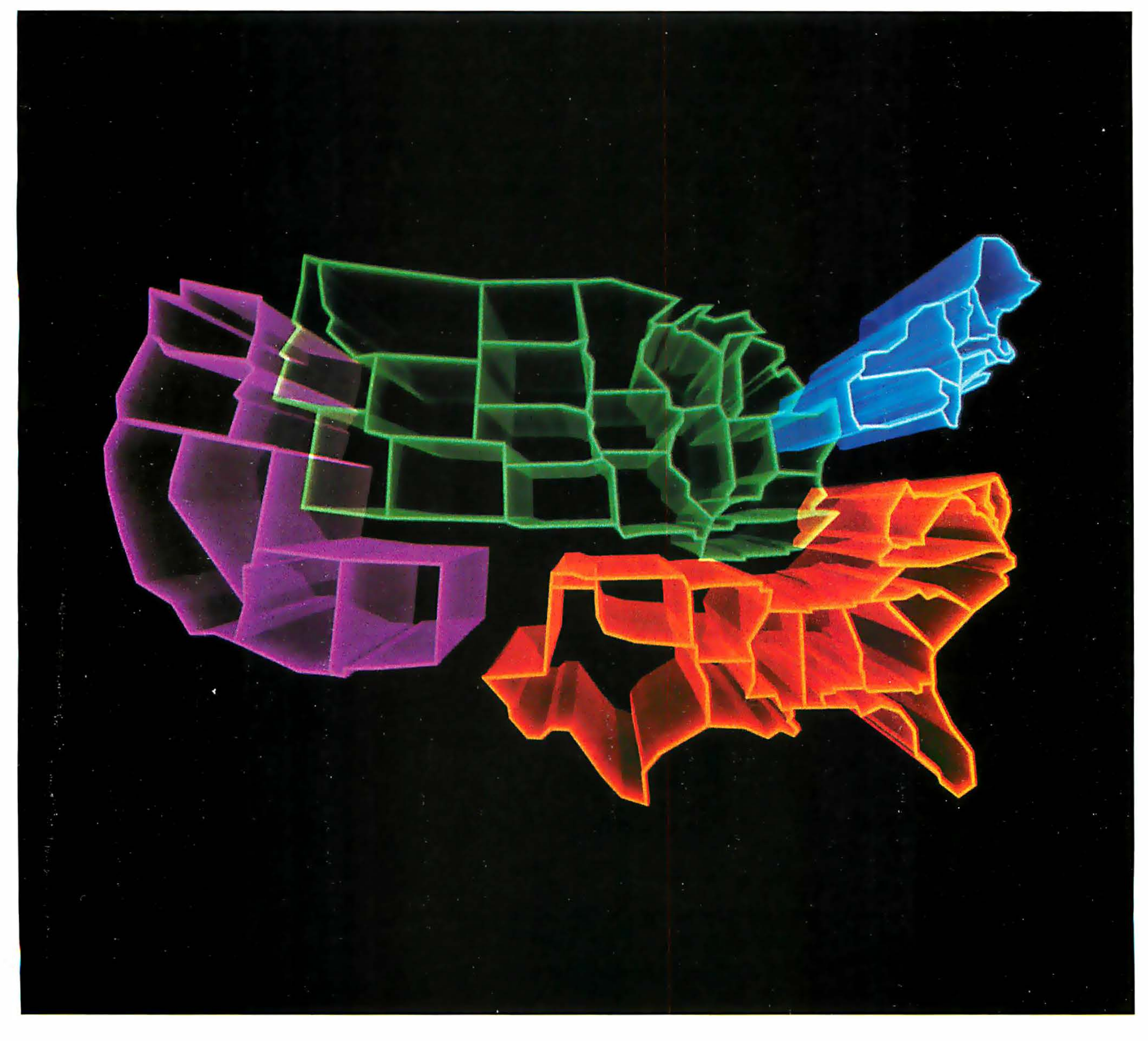
Price: $119.
Contact: Microlytics, Inc., Two Tobey Village Office Park, Pittsford, NY 14634, (716) 248-9150.
Inquiry 1167.

continued

BYTE

REGIONAL

MIDWEST



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Users Groups Past, Present, and Future

Well, what do I do now?" This question has been asked countless times as new PC users stare at the just-unwrapped collection of parts that they must assemble into a working computer. From the beginning of the PC revolution, the answer has often been, "Join a users group."

What began as an assembly of users trying to learn more about the new machines is now a social institution. From the beginning, users groups have provided technical support to novices and expert users, beta testers for new products, feedback to hardware and software vendors on their new products, and much more.

The first issue of BYTE dedicated two pages to users group news, including a notice that the Amateur Computer Group of New Jersey had held its first meeting on June 13, 1975. That group continues to operate to this day and is often associated with the Trenton Computer Festival. For our 15th anniversary issue, BYTE asked several users group officers across the U.S. to reflect on the status of users groups and their challenges in the future.

Playing Mom to 700 People

With the responsibility of coordinating more than 50 users groups and 700 volunteers of the Boston Computer Society, Pam Bybell says that her job is "sort of like Mom, with lots of children screaming at once."

As manager of users group support for the BCS, which currently boasts a membership of about 40,000, Bybell helps volunteers refine their ideas and find the necessary resources for putting their ideas into action.

Bybell says that the BCS struggles to some degree with the same problems facing smaller groups and offers several strategies to deal with common problems, particularly volunteer burnout.

"One thing we try to get across to a group is that you have to have a deep bench," she says. Often, a person who starts a users group or special-interest group is by nature creative, exciting, and driven. At first, this person may think nothing of organizing meetings, putting out a newsletter, and running the group mailing list. Several months into the job, however, you've got a prime candidate for burnout. That's why delegating tasks, though difficult, is so important, she says.

"If you learn nothing else as a volunteer, you better learn to delegate," Bybell stresses. She often cites the Truck Theory to drive this point home. The Truck Theory says that if a volunteer were hit by a truck and died, and the group too would die, then that person is doing too much. She also says that if an activity isn't fun, you shouldn't be doing it, and notes that group members are quick to recognize trouble and political infighting.

As for the challenges for

continued

USERS GROUPS PAST, PRESENT, AND FUTURE

the BCS and other groups in the next few years, she cites a few. One is that groups must serve an expanding range of users, from novice to corporate member. Another is reconciling the role of the group to the corporate environment. Many times, she says, corporate members "tend not to understand that a volunteer can't be called at work" for technical support.

One improvement Bybell sees is in the area of support provided by hardware and software vendors. Here, she says, "things are light-years better" than in earlier days.

Like other groups, the BCS is also becoming involved in community service to nonmembers, matching mentors to other nonprofit organizations, acquiring used equipment for the organizations, and, in some cases, donating time to get the machines up and running.

So what makes the BCS so successful? According to Bybell, the secret is "letting volunteers do the things they want."

Computing Down East

Rowan Wakefield remembers the first computer fair sponsored by the Island/Reach Computer Users Group and how surprised participating vendors were by the early-morning rush of people. By 8:15 a.m., he says, the hall was packed "shoulder to shoulder with people. Around here, people just get started early." The fair, which attracted about 30 exhibitors and 800 people, was going strong until a blizzard hit around 4:30 p.m., sending people home.

The "here" that Wakefield refers to is the area near Bangor, Maine, where group members live in towns such as Deer Isle, Blue Hill, and Bar Harbor. In three years, the group has increased its membership from 30 to more than 300. Wakefield, president of the club, says the occupations of members range from "lobstermen to retired newspaper editors . . . to teachers and writers."

Wakefield saw the need for a multiplatform group when he attended an Epson users group meeting and only one other person showed up. He and two others envisioned a generic users group in a rural area that could provide useful services. About 30 people showed up for the first meeting, and the group was on its way.

Wakefield says that one way the group fights burnout is to contract out the production of its newsletter to a prepress production house. Members write the stories, which are transmitted to the editor via the Celebration Station BBS, a popular BBS run by Noel Stookey, of Peter, Paul, and Mary fame. However, burnout is still an issue: Wakefield says he will not seek reelection for the next term.

As the group matures, Wakefield sees the emphasis shifting from growth to providing more services for current members. The group plans to sell a book called *50 Ways to Make Money With Your PC*, which is based on one of the group's most suc-

continued

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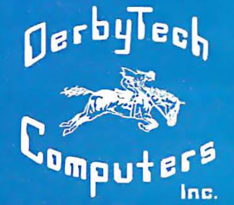






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cessful workshops.

Wakefield claims that he isn't a high-tech person but is fascinated by the role of technology in society. "Regardless of the subject, the group's role has been keeping up with the leading edge of change and helping members understand it. Users groups have the responsibility to interpret or translate these impending changes and what they mean for the guy on the street."

The $20,000 Question

Take a users group that's growing by leaps and bounds. Add an all-volunteer staff, particularly a treasurer who volunteered for the job thinking it might require just one weekend a month. Add a $100,000 annual budget, and you get a recipe for a disaster waiting to happen.

In the case of the Portland Macintosh Users Group, this combination resulted in a discrepancy of about $20,000 between what the group thought it had and what it really had, according to former PMUG president Allan Foster. He says that the discrepancy fueled a very nasty political battle that polarized the board of directors and general members alike. [Editor's Note: *After a lengthy internal investigation, no formal charges were filed in the case.*]

Of course, PMUG is not the only users group to suffer from inner turmoil. Almost every users group at some time sees clashes among members with different agendas. For example, the Houston Area League of PC Users last year revised its bylaws, a process that generated considerable controversy among special-interest group leaders and other officers. The process also resulted in the abrupt resignation of key officers.

According to Foster, these growing pains are natural as users groups evolve from club status to something that more closely resembles a professional society. And as new members enter the group, conflicts arise concerning the purpose of the group.

When PMUG first formed, Foster says, the group met in someone's living room. At that time, the group consisted "basically of people who'd just hooked up their 128K Macs and were wondering what to do with all that power." The group now has about 1300 members.

Often, as a group's membership increases, you still have the same people volunteering their time for the group. But as Foster points out, "It's easier to manage a group of 200 with four or five volunteers than a group of 2000."

During the missing-funds controversy, Foster says, he decided he'd had enough. As accusations and counter-accusations were made at meetings and in the newsletter, Foster thought, "Hang on, I've got a real life and there are other things I can be doing."

"What the controversy told me was 'Oh, I don't want to be a part of this,'" he says. He describes the new leadership as "a decent bunch, ones who care about the group."

What can a group do when faced with massive growth? Foster says that one possible solution is to hire a paid staff, as the Berkeley Macintosh Users Group and the Boston Computer Society do. "But you have to get above a critical mass to be able to do that," he points out. Another solution is to pay consultants their usual fee for conducting workshops and cover the fee with a nominal tuition charge. A more obvious solution is to recruit more volunteers.

But, somehow, the group's management structure has to change. As Foster says, "There's no way that a person who stood up and was going to [act as treasurer] on the weekends is going to manage a $100,000 budget."

Ask Not What Your Group Can Do for You

"What's in it for me?" The next time you're asked this as you try to recruit a new member, instead of explaining the virtues of the general meetings, software library, and free advice, you might try this response: "If you have to ask, we're not sure you're our kind of member."

This approach seems to work just fine for the Central Kentucky Computer Society. According to newsletter editor David Reed, the group encourages new members to get involved from the beginning instead of just showing up for the main meetings.

The group, which will celebrate its sixth anniversary next month, now has about 600 members. Attendance at the monthly general meetings has increased from about 40 to 150.

The attitude of the group as a whole was reflected last April, when the CKCS sponsored a computer show. According to Reed, the board of directors expected about 20 volunteers to help run the show. But on the day of the show, the number was closer to 50 volunteers.

It's this kind of enthusiasm that pays off: Reed estimates that the group added 100 new members as a result of the computer show. He notes that the group encountered burnout two years ago. "So we just expanded the board of directors," he says.

In addition to editing the newsletter and working as a news editor for the Lexington *Herald-Leader*, Reed moderates the Users Group Exchange (UGX) on BIX and participates in the Association of PC Users Groups BBS. He says that the BBSes are becoming a good way for group editors and presidents to share information, discuss problems, and, in UGX, download daily news feeds for their own BBSes and newsletters.

Reed thinks that BBSes are also a good vehicle for users groups to use to iron out ethical problems. "The good groups are trying to influence the less-than-pure groups," he says.

Flipping Between Two Sides of the Coin

One side of the coin says that users groups need to be entertained by vendors with slick product demonstrations and free products. The other side says that the groups provide valuable technical assistance for users while helping vendors in the product development process by acting as beta testers and suggesting new features. Jay Bartlett is intimately familiar with both sides of the coin.

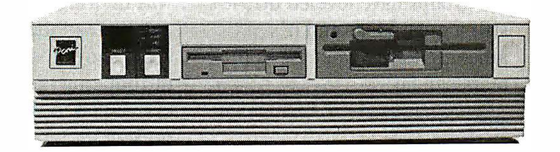
As president of the Gold Coast Macintosh Users Group of Miami, Florida, and marketing manager for Tactic Software, he understands the importance of the users group as a marketing vehicle for vendors. He also knows how hard it can be to schedule the monthly meetings at which so many members expect to be entertained.

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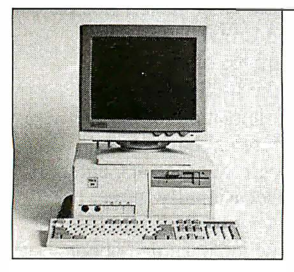


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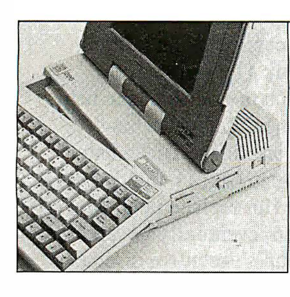
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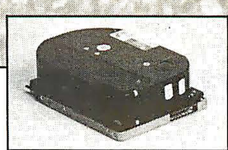
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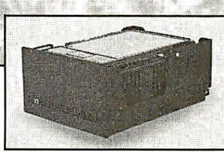
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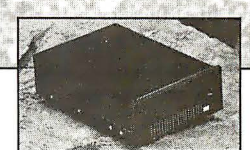
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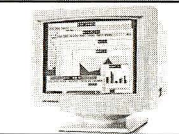


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Bartlett says that in addition to providing input for product features, users groups act as a proving ground for hardware and software products. "Vendors can't possibly test their applications with every other application out there, especially in the Mac market," he observes. (Tactic Software sells a number of utilities for the Mac, including Icon-It, which puts icons on the screen for easy access, and Clairvoyant, a tool for writers.)

Because his users group is located in a large metropolitan area, Bartlett says, he can often attract good speakers from major developers. Eventually, however, members come to expect high-quality presentations every month, but they don't provide much input as to what they want to see.

"We need their input," he says. "But these people are sitting in the back with their shades on, and as soon as the break comes, they're gone."

Bartlett thinks that users groups aren't the only organizations with this problem. "There are always going to be those who do the work and others who follow, be it computers or Little League."

Three Meetings Are Better Than One

One of the realities of attending users group meetings is the dog-and-pony show, in which vendors extol the virtues of their products to an attentive audience and then sell or donate the product to members after the meeting. These shows are valuable to the vendors as a marketing tool and to the users who want to see the latest products.

Conflict occurs when you take a users group such as the New York Personal Computer Group, which tries to stay away from product-oriented talks for its general meetings while booking speakers with a wide knowledge of the industry. The group solves this conflict with the sponsored general meeting concept.

In sponsored general meetings, which are arranged on an as-needed basis, the group makes personal invitations to individual members to attend company presentations. According to NYPC president David Hoffman, one reason for the group's success is this independence. The group holds its mailing list tightly to its vest.

Founded in 1982, NYPC has more than 50 special-interest groups. The SIGs' monthly meetings provide a third type of meeting format. For the past three years, the group has also sponsored the Intergalactic Users Group meeting, which, among other things, features a newsletter competition.

The North Texas PC Users Group, based in Dallas, does a variation of the three-format meeting. For its general meetings, the group meets at the Infomart with about 50 other users groups and sponsors three programs over the course of the day. Each program revolves around a general theme or a specific product.

Over the years, users groups have gained respect from the user community, vendors, and local dealers, Hoffman says. "The concept of users groups is still alive and well. Although many of the groups have leveled off, it's still a great idea, and it's amazing to see what the volunteers can do."

From Humble Beginnings to Supergroup

Jonathan Rotenberg remembers the first few months of the Boston Computer Society, when the group consisted of just a few people, some of whom didn't even own a computer, meeting in a high school library. "It would be so discouraging. At times I thought, if I don't show up tonight, this will be the end of the BCS."

As a tenth grade student, Rotenberg was trying to convince his high school to buy a computer so that he and others could learn how to program. To make himself more credible to school authorities, he decided to research computers. He soon discovered, though, that the kind of information he needed was scarce.

In late 1976, Rotenberg saw a flyer for a radio talk show starting on the Boston University radio station and contacted the host of the show to ask if he knew of any local users groups. He didn't, but he mentioned that several other people had asked him the same question. The two decided to form such a group. Rotenberg still hadn't convinced his school administrators to buy a computer, but they did let him use the library for the first meeting of the BCS.

Two people showed up for the first meeting. "One of them had wandered in by accident," Rotenberg says. However, six people showed up for the second meeting, and by the fifth meeting, the group was inviting guest speakers.

At one of the meetings, the radio show host, who had been introducing the guest speakers, failed to show up for the presentation by Wang. Rotenberg, whose voice at the time was changing, got up and very nervously introduced the guest speaker. The next day, the radio show host said that his priorities had changed and he could no longer run the meetings. Rotenberg says he later learned that the host had shaved his head and joined a commune in Austria.

Rotenberg thought the BCS would fold when he left Boston to attend Brown University. But members of the group moved the BCS paperwork and equipment out of Rotenberg's parents' house to a tiny storefront space at Center Plaza. Occasionally, street people wandered into the office, which occupied about 400 square feet.

The group hired a part-time receptionist, and Rotenberg took a bus home from school on the weekends to help run things. Rotenberg returned one day to find a letter of resignation from the receptionist. Her replacement, Mary McCann, eventually became the group's executive director and editor of the *BCS Update*.

It was from these inauspicious beginnings that the BCS eventually became the world's largest computer users group.

"I had no idea the BCS was going to turn into a real organization," Rotenberg says. "There was really no master plan behind it. In the tenth grade, I was just trying to convince school officials to buy a computer."

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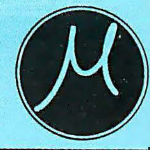
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MICROCOM 286/12

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Hard Drives: MB/Ms	20/40	42/28	65/28	80/18	105/18
No Video	$749	$849	$949	$1,149	$1,249
Mono	$674	$974	$1,074	$1,274	$1,374
VGA-Mono	$1,049	$1,149	$1,249	$1,449	$1,549
SVGA	$1,299	$1,399	$1,499	$1,699	$1,799
Hires	$1,399	$1,499	$1,599	$1,799	$1,899

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* DOS 3.30 or 4.01 Included

386SX/16 Standard System *$699*

Standard System Features plus:
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* 1 MB RAM Standard (Expandable to 8 MB RAM)
* 0 Wait State Performance for 21 MHz Effective Throughput
* Landmark = 21.0 MHz - Norton SI = 18.4x
* AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

MICROCOM 386SX/16

386SX/16 System Features, Hard Drive, Monitor & Video Card

Hard Drives: MB/Ms	42/28	65/28	80/18	105/18	205/18
No Video	$1,049	$1,149	$1,349	$1,449	$1,799
Mono	$1,174	$1,274	$1,474	$1,574	$1,924
VGA-Mono	$1,349	$1,449	$1,649	$1,749	$2,099
SVGA	$1,599	$1,699	$1,899	$1,999	$2,349
Hires	$1,699	$1,799	$1,999	$2,099	$2,449

386SX/16 Super VGA System *$1,699*

* 386SX/16 Standard System
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* 14" Color Super VGA Monitor with 800 x 600 Resolution and 0.31 dot pitch
* DOS 3.30 or 4.01 Included

386/25 Standard System *$1,199*

Standard System Features plus:
* Intel 80386DX Processor running at 25 MHz
* 1 MB RAM Standard (Expandable to 8 MB RAM)
* 0 Wait State Performance for 34 MHz Effective Throughput
* Landmark = 34.5 MHz - Norton SI = 29.7x
* AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support
* for 64 KB Cache, add $300
* Landmark = 45.9 MHz - Norton SI = 39.6x

MICROCOM 386/25

for 64 KB Cache, add $300

386/25 System Features, Hard Drive, Monitor & Video Card

Hard Drives: MB/Ms	42/28	65/28	80/18	105/18	205/18
No Video	$1,549	$1,649	$1,849	$1,949	$2,299
Mono	$1,674	$1,774	$1,974	$2,074	$2,424
VGA-Mono	$1,849	$1,949	$2,149	$2,249	$2,599
SVGA	$2,099	$2,199	$2,399	$2,499	$2,849
Hires	$2,199	$2,299	$2,499	$2,599	$2,949

386/25 Super VGA System *$2,199*

* 386/25 Standard System
* 42 MB Hard Disk w/Quick 28 ms Access Time
* Second 5.25" 1.2 MB or 3.5" 1.44 MB Diskette Drive
* High Performance 16-bit 512K VGA Graphics Card w/1024 x 768 Capability
* 14" Color Super VGA Monitor with 800 x 600 Resolution and 0.31 dot pitch
* DOS 3.30 or 4.01 Included

386/33C Standard System *$1,699*

Standard System Features plus:
* Intel 80386DX Processor running at 33 MHz
* 1 MB RAM Standard (Expandable to 8 MB RAM)
* 64 KB Static RAM Cache for Increased Performance
* 7 Million Instructions Per Second (MIPS) Operation
* Landmark = 56.0 MHz - Norton SI = 45.9x
* AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

MICROCOM 386/33C

386/33C System Features, Hard Drive, Monitor & Video Card

Hard Drives: MB/Ms	42/28	65/28	80/18	105/18	205/18
No Video	$2,049	$2,149	$2,349	$2,449	$2,799
Mono	$2,174	$2,274	$2,474	$2,574	$2,924
VGA-Mono	$2,349	$2,449	$2,649	$2,749	$3,099
SVGA	$2,599	$2,699	$2,899	$2,999	$3,349
Hires	$2,699	$2,799	$2,999	$3,099	$3,449

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* Landmark = 117.0 MHz
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486/25C, System Features, Hard Drive, Monitor & Video Card

Hard Drives: MB/Ms	80/18	105/18	205/18	340/18	650/16
No Video	$4,949	$5,049	$5,399	$6,099	$7,099
Mono	$5,074	$5,174	$5,524	$6,224	$7,224
VGA-Mono	$5,249	$5,349	$5,699	$6,399	$7,399
SVGA	$5,499	$5,599	$5,949	$6,649	$7,649
Hires	$5,599	$5,699	$6,049	$6,749	$7,749

486/25C Hires System *$5,999*

* 486/25C Standard System
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* DOS 3.30 or 4.01 Included

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Circle 1317 on Reader Service Card

Step Back 550 Million Years

If Bill and Ted had used this time machine on their excellent adventure, they could have found themselves surrounded by dinosaurs rather than French nobility. The Time-Machine Earth lets you view Earth's geological history as far as 550 million years in the past or 40 million years in the future.

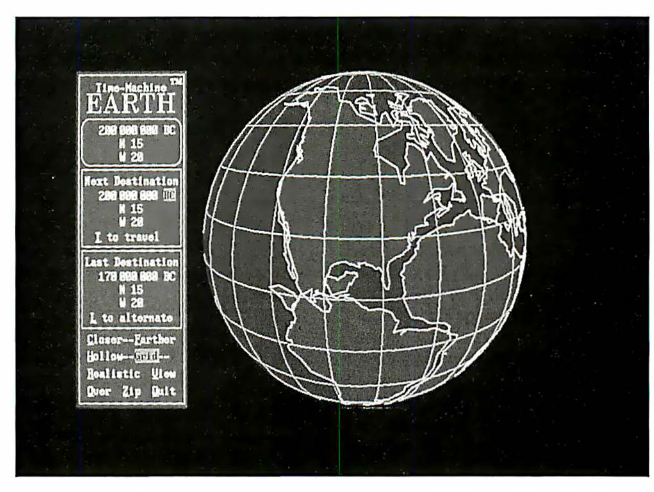
The program lets you see the land the dinosaurs walked or view the results of the comet that may have caused their extinction. You can view maps of the globe that show the positions of the oceans and continents at any period. A blink comparison function lets you toggle between views of two eras, and you can superimpose images of different time periods.

The program runs on the IBM PC with 256K bytes of RAM.

Price: $69.95.

Contact: Sageware Corp., 1282 Garner Ave., Schenectady, NY 12309, (518) 377-1052.

Inquiry 1004.



According to the theory of continental movement, shown by Time-Machine Earth, the continents may soon, in geological terms, fit together like a puzzle. For you and me, that means tens of millions of years from now.

Put a Stock Analyst in Your IBM PC

An on-line stock trading program called MyWay helps you manage diverse portfolios by providing buying and selling recommendations based on your trading style and financial resources, MoneyWon reports.

MyWay acts like an analytical decision support system, calibrating stock positions and issuing precise recommendations.

MyWay can calculate rates of return on an annual basis and includes commission costs in all its figures. It also oversees your position in the market through a profit report module and lets you do what-if analyses.

MyWay runs on the IBM PC with 512K bytes of RAM and a modem. The program interfaces with most on-line financial information systems.

Price: $395.

Contact: MoneyWon, Inc., Ten Tower Office Park Dr., Woburn, MA 01801, (800) 463-6639 or (418) 622-2211.

Inquiry 1006.

Fetch Missing Files from Within DOS Applications

Zaphod Industries' File Fetch utility lets you find missing files without having to exit your current MS-DOS application. You can search for other files across subdirectories, local drives, and network drives while you're still within your current application, the company reports. When the program finds the file, it returns the file path to your current application's prompt line, awaiting further action by you. This saves time and helps to prevent typos.

Price: $39.95.

Contact: Zaphod Industries, P.O. Box 442, Northwood, NH 03261, (603) 942-5077.

Inquiry 1005.

Why Put Great Ideas on Boring Paper?

OK, so you can't measure it by MIPS, megahertz, or MFLOPS, but that doesn't mean that your laser or dot-matrix printer paper must always be the same old unglamorous, plain vanilla stock.

PaperSelect offers a paper kit that contains hundreds of sheets of paper and envelopes in many styles, colors, weights, and finishes. The kit includes a paper selector that contains swatches and specifications of every paper available from the company and a catalogue.

Price: $14.95, refundable with your first order; free with orders of $25 or more.

Contact: PaperDirect, Inc., 57 Romanelli Ave., South Hackensack, NJ 07606, (800) 272-7377 or (201) 342-6432.

Inquiry 1007.

Create Fractal Images from Simple Patterns

Cedar Software's new fractal drawing program for the IBM PC starts with a simple pattern that you create and draws the rest, generating complex fractal images.

Once the program is done drawing the image, you can spin, skew, grow, shrink, and otherwise manipulate any part of it. You can then carry all the changes through all levels of the drawing.

Fractal Grafics consists of templates of abstract art, lettering, scientific models, and other fractals.

Price: $79.

Contact: Cedar Software, Morrisville, VT 05661, (802) 888-5275.

Inquiry 1008.

Write a Will with Your PC

Jacoby & Meyers Law Offices has teamed up with programmers of the College Explorer program to create WillPower, which helps you write your will.

WillPower provides legal information about the state in which you live or own property and helps you plan financially for spouses and children, establish trusts, name guardians, designate an executor, and address other considerations in creating a will.

The program runs on the IBM PC with 512K bytes of RAM.

Price: $49.95.

Contact: Jacoby & Meyers Law Offices, 1156 Avenue of the Americas, New York, NY 10036, (800) 233-3109 or (212) 536-7600.

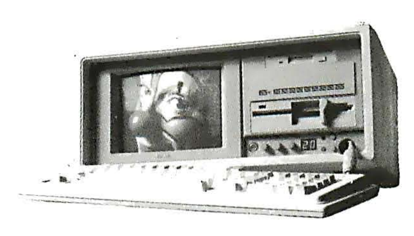
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- VGA Plasma Screen, 640x480 Res.
- External VGA Monitor Adaptor
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- 87-Key Keyboard, Carring Bag.
- One 16-Bit Exp. Slot Available.

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- External VGA Monitor Adaptor
- 286-16 MHz System Board
- 1MB RAM on Board. (Expandable to 2 or 5MB Optional)
- 3.5" 1.44MB Floppy Drive.
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- 84-Key Keyboard, Carring Bag.
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- One 16-Bit Exp. Slot Available.

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386-33 100MB COLOR VGA PORTABLE

- Built-in SONY 8.5" Color VGA Monitor 0.26mm Dot Pitch, 800x600 Resolution
- Speed Digital Display. 3 Drive Bays
- 220W P/S 110/220V. 4 Exp. Slots
- 86-Key Detachable Keyboard
- 386-33 MHz CPU, w/32K Cache Memory
- 1MB Memory on Board (To 8MB)
- VGA Graphic Card (256K, 800x600 Res.) (512K, 1024x768 Res. + $50) External Monitor Adaptor
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- Carrying Bag. Weight 27 Lbs.
- Dimensions: 17.5(W) x 14.1(D) x 6.8(H)
- 7 expansion Slots Model Optional

$3,659 (Special)

HDD	286-12	386SX	386/25	386/33	486/25
40MB	2209	2469	2839	3239	4859
100MB	2629	2889	3259	3659	5279
150MB	2909	3169	3539	3939	5559
200MB	3019	3279	3649	4049	5669
345MB	3809	4069	4439	4839	6459

VGA AMBER CRT PORTABLE 65MB AT

- Built-in 9" Amber VGA Monitor
- Speed Digital Display. 3 Drive Bays
- 205W P/S 110/220V. 4 Exp. Slots
- 86 Keyboard, Detachable Keyboard + $30
- AT 12 MHz System, 1MB Memory (To 4MB)
- VGAGraphic Card (256K, 800x600 Res.)
- Run 48 Grey Scales VGA Internally Run Color VGA Externally
- 1.2MB or 1.44MB FDD
- 65MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- Carrying Bag. Weight 26 Lbs
- Dimensions: 17.5 (W) x 14.1 (D) x 6.8 (H)

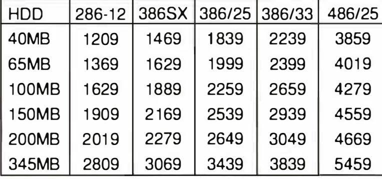
$1,639

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1479	1739	2109	2509	4129
65MB	1639	1899	2269	2669	4289
100MB	1899	2159	2529	2929	4549
150MB	2179	2439	2809	3209	4829
200MB	2289	2549	2919	3319	4939
345MB	3079	3339	3709	4109	5729

AMBER CRT PORTABLE 65MB AT

- Built-in 9" Amber Monitor
- Speed Digital Display. 3 Drive Bays
- 205W P/S 110/220V. 4 Exp. Slots
- 86 Keyboard, Detachable Keyboard + $30
- AT 12 MHz System, 1MB Memory (To 4MB)
- Mono or Color Graphic Card
- Amber EGA Display (option) + $100
- 1.2 MB or 1.44 MB Floppy Drive
- 65MB 26ms Toshiba Drive
- Carrying Bag Weight 26 lbs.
- Dimensions 17.5(W) x 14.1(D) x 6.8(H)

$1,369



HDD	286-12	386SX	386/25	386/33	486/25
40MB	1209	1469	1839	2239	3859
65MB	1369	1629	1999	2399	4019
100MB	1629	1889	2259	2659	4279
150MB	1909	2169	2539	2939	4559
200MB	2019	2279	2649	3049	4669
345MB	2809	3069	3439	3839	5459

COLOR EGA CRT Portable Available

386-33 100MB VGA PLASMA PORTABLE

- 640x480 VGA Plasma Display
- Detachable 101-key Keyboard
- 200W P/S, 110/220V. 3 Drive Bays
- 386-33 MHz CPU, w/32K Cache Memory
- 1MB Memory on Board (To 8MB)
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial and Parallel Ports
- External Monitor Adaptor
- Carrying Bag. Weight: 26 Lbs.
- Dimensions: 16"(W) x 9.75"(H) x 8.5"(D)

$3,429

HDD	286-12	386SX	386/25	386/33	486/25
40MB	2019	2279	2649	3049	4669
65MB	2169	2429	2799	3199	4819
100MB	2399	2659	3029	3429	5049
150MB	2659	2919	3289	3689	5309
200MB	2759	3019	3389	3789	5409
345MB	3529	3789	4159	4559	6179

CGA PLASMA PORTABLE 65MB AT

- 640X400 CGA Plasma Display
- Detachable 86-Key Keyboard
- External RGB Monitor Adaptor

$1,619

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1469	1729	2099	2499	4119
65MB	1619	1879	2249	2649	4269
100MB	1849	2109	2479	2879	4499
150MB	2109	2369	2739	3139	4759
200MB	2209	2469	2839	3239	4859
345MB	2979	3239	3609	4009	5629

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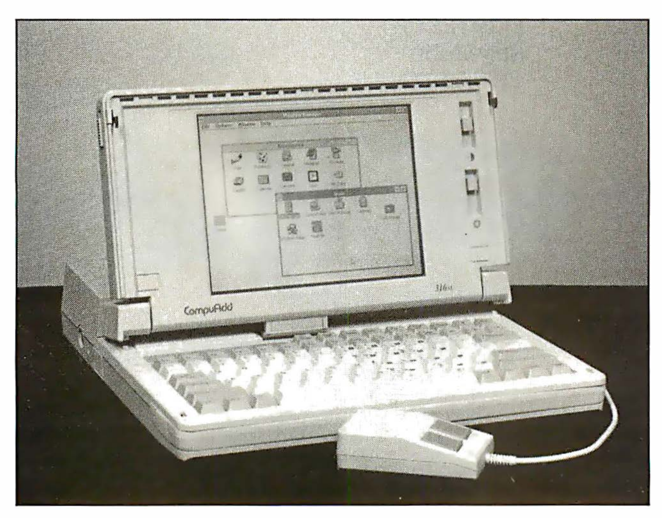
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CompuAdd's first laptop computer, based on the 16-MHz 386SX processor, comes with Windows 3.0, DOS 4.01, the DOS Help utility, and the LapLink communication program. The 316SL also has 2 MB of memory (expandable to 6 MB), a 40-MB hard disk drive, a 3½-inch floppy disk drive, and a VGA screen.

The system can display 16 shades of gray on the 8- by 6-inch VGA screen. If that's not good enough, you can connect an external monitor via a VGA video port. The 316SL weighs 11½ pounds.

Price: $2895.
Contact: CompuAdd Corp., 12303 Technology Blvd., Austin, TX 78727, (512) 250-1489.
Inquiry 1010.



The CompuAdd 316SL uses 12-V and nickel-cadmium batteries and ships with power-management software. The 316SL weighs 11½ pounds.

Point of Sale for Smaller Retail Companies

The Electric Merchant point-of-sale program for the IBM PC lets retail clerks easily record sales, print receipts, and look up stock information while providing management with security, customizable reporting, and inventory control, Software Creations says.

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You can set up the system to tell you when a store has reached a minimum number of products. Business reviews include store sales history on any day, sales tax reporting, error checking, and cost of goods sold. The program tracks each sale by category, salesperson, and payment type.

Price: $995.
Contact: Software Creations, Inc., 10035 Adamo Dr., Tampa, FL 33619, (800) 767-3279 or (813) 684-8291.
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The utility works with different versions of AutoCAD ranging from release 2 up to release 10, according to AutoSight.

Price: $195.
Contact: AutoSight, Inc., P.O. Box 362086, Melbourne, FL 32934, (407) 242-5865.
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Price: $89; additional quote bases, $25 each.
Contact: PennComp, 4031 Villanova St., Houston, TX 77005, (800) 326-6145 or (713) 669-0965.
Inquiry 1012.

Pop-up Mail for LANs Requires 7K Bytes

Nouveau is a pop-up mail system designed for the rapid entry and retrieval of messages on any DOS-based network. A TSR program, it lets you send and receive messages of up to 900 characters. When you activate the program, Nouveau displays a window with a list of messages that you haven't read.

Price: $25 per workstation.
Contact: Integra, P.O. Box 72063, Marietta, GA 30007, (404) 973-3586.
Inquiry 1014.

Pop-up Calculator Solves Time-Based Problems

With QS-Timecalc, you can carry out a variety of time-based calculations on employee time cards, client billing charges, computer usage logging, and totaling time-based processes. You can make the program RAM-resident and use it with your current IBM PC payroll or billing application, Quingen says.

Price: $39.
Contact: Quingen Systems, Inc., 530 Causeway Dr., Wrightsville Beach, NC 28480, (919) 256-9119.
Inquiry 1015.

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FIFTEEN YEARS AND COUNTING

A black-tie affair lets Jerry reminisce

We're at Spring Comdex, and I've just attended BYTE's 15th anniversary party. It was a very elegant black-tie affair held at The Mansion, one of Atlanta's spiffier restaurants. There was caviar, and an ice sculpture that spelled out BYTE, and all manner of expensive food and drinks; but I couldn't help remembering the old days, when you'd see more beards than suits at a BYTE affair, and the party would be an informal gathering in a local pizza place.

All things change, of course. When BYTE first started, the president/CEO of a start-up company was likely to be a young technoweenie who understood computer chips and programming, but not much else. Then came the era of the financial people, who put up the money and wanted to run the show personally, often with disastrous results. Now the CEO will be in a suit, clean shaven, with a background in marketing, and the technoweenie who thought up the project will be carefully kept in the background, if allowed to come to Comdex at all.

Or worse: I went through one expensive booth today in which the PR lady knew nothing technical about her product. She referred me to the product manager. He didn't know how much memory his device drivers took up (and didn't know what a device driver was). He referred me to their "technical person"—who didn't know it either. So it goes.

Still, there are start-up companies who compete with pure technological excellence rather than slick marketing; for example, Sota and USVideo. Many were at the BYTE party. Others showed up at the Silicon Northwest party. (This is a consortium of Northwest-based companies who show their products while guests scarf up northwestern salmon, clams, wines, and suchlike.) Others were at Tech Southeast, now the best party at Comdex.

Dan Bricklin and Bob Frankston, the original "beards who made good," were there. They haven't much changed, and are still BYTE readers. Ironically, their VisiCalc program was the beginning of the end for the computer industry that BYTE originally served.

VisiCalc, the first spreadsheet, was the first program that every business not only needed, but instantly *knew* that it needed. I recall businesspeople in computer stores saying, "I want a VisiCalc." The clerks explained that VisiCalc was a program, and you needed an Apple to run it on. (Bricklin and Frankston wrote VisiCalc on an Apple because that's what they happened to have.) "Yeah, yeah, fine, whatever it takes, but I gotta have a VisiCalc."

Prior to VisiCalc, most people who owned computers understood them or wanted to. They wanted to learn more about programming and how to upgrade their system and which chips were best. They read BYTE, and complained if the articles weren't technical enough. Many built computers from kits.

Those were the times of incredibly rapid change. Memory boards doubled in size from one issue to the next. Every month, there were amazing new programs that could do things we had confidently predicted wouldn't happen for years. Bill Godbout's CompuPro would have a new marvel at every show. Marketing consisted largely of bragging about technical specifications. You can read all about those days in my two books, *The User's Guide to Small Computers* and *Adventures in Microland*, both from Baen Books.

After VisiCalc, there was a shift. The computer community never lost any of the enthusiasts—indeed, their numbers continued to grow—but they were first outnumbered and then swamped by the influx of the suits, and the users who didn't care what was in the computer or how it worked, as long as it got the job done. I can hardly complain, of course, since I'm one of them; but I do remain curious about how the machines work.

As the senior writer on the editorial staff—the only editor who's been with BYTE longer than me is my copy editor Warren Williamson—I've watched all these changes happen, but it was particularly brought home tonight by the elegance of BYTE's 15th anniversary party. I enjoyed that party very much, and I collected a ton of business cards and listened to glowing descriptions of products that are shipping, and others that will be out Real Soon Now.

But I also enjoyed getting away from it and out to a smaller gathering of the hackers who love this technology for its own sake and whose enthusiasm makes it happen. I can drink champagne with the new market-oriented CEO, and that's fine; but I'm glad I can still get out to a pizza parlor with the beards. BYTE still talks to beards and hackers as well as to suits and users; and I like that a lot.

Pournelle's Laws

Over 10 years ago, my BYTE columns proclaimed "Pournelle's Laws." I confess that the number of those laws has varied over the years, but the first two have been here from the beginning: "One user, one CPU"; and "Silicon is cheaper than iron."

I have modified the First Law. It now reads, "One user, at least one CPU." This is not a change in principle, since from the beginning the point was to advocate decentralized computing. That's a battle that has largely been won; but some of today's readers may not realize just how bitter that fight was. In the early days, computing, especially in corporate centers, was highly centralized. There would be a great Hulking Giant of a machine enthroned on platforms in an

continued

air-conditioned room, attended and approachable only by priests in white coats. Ordinary users seldom even *saw* the machine, and none were allowed to touch it.

Moreover, departments weren't allowed to have small computers. The usual trick was that the central computing department would buy what was then a machine of great capacity, because that was thought to be needed for some primary problem. That task wouldn't use anything like all the central computer's capacity, so other departments would then be required to use its services and pay for them.

If a department head wanted a particular kind of report, the director of computing would have special programs written to provide it—and would charge the department an outrageous fee for the service. There were few commercially available programs; nearly every program was custom-written for a particular company. Often the programming was done by IBM or another mainframe vendor, and the customized programs were not sold but leased for tens of thousands of dollars a year.

From early on this was silly, but after the development of VisiCalc and dBASE II, the absurdity became obvious: even in 8080/Z80 days, microcomputers could provide more information, faster and better tailored to a department's needs, than ever could the Hulking Giant in the basement. Pournelle's Law, One user, one CPU, was a declaration of independence from Central Computing.

After that battle was won, there was still the war against multiuser microcomputers, which I consider a compound absurdity. The corollary to Pournelle's First Law is "Networks, not multiuser." It was one reason I remained opposed to Unix, which has always been a multiuser scheme and has been used to justify enormous central systems.

I have no objections to large central systems, provided that there's something real for them to do and, more important, that they are networked to independent workstations. The central system can provide central databases, networked automatic backup capabilities, and suchlike; but the heart of the computer revolution is to provide each employee with tools not lock-stepped to everything else; to liberate individual creative energies; to let people do things their own way. That battle is not yet won. Diskless workstations are the latest ploy in the eternal war of the centralists against the rest of us. It's important to remain vigilant.

The Second Law—"Silicon is cheaper than iron"—originally referred to bus systems. When first formulated, the Law referred to the S-100 bus versus "all-up" or turnkey machines like the Exidy Sorcerer. In modern times, it's the difference between machines with slots for third-party hardware and those without.

What I meant, then and now, was that it is a lot cheaper to upgrade your system by changing or adding boards than to throw it away and start over. A large part of my original opposition to the Apple Macintosh was because the original Mac was an all-up machine with a proprietary bus and operating system, designed to cut out third-party hardware developers. That tends to be forgotten now that the Mac II has slots.

I see no reason to apologize for the Second Law, but it did lead to the least successful of my predictions. I thought that mass storage systems based on high-

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precision spinning metal would soon go away, to be replaced by some kind of chip-based device: bubble memory, holographic memory, nonvolatile memory chips; I wasn't sure what would do the job, but I was certain something would come up to replace the hard disk.

That's likely to be true sometime in the future; but I thought it would happen well within the decade of the 1980s, and clearly it has not. In my defense, when I said this in 1978, even 10-megabyte hard disk packs were as large as—and sounded like—washing machines. What I failed to do was to factor in the success of the microcomputer revolution: decentralized small computers not only allowed the design of better hard disk drives, but by controlling robots, greatly lowered the cost of their production.

The Information Revolution

In one of my first BYTE columns, I said that by the end of the millennium, any member of Western Civilization would be able to get the answer to any question that has an answer—and this at reasonable cost. I see no reason to revise that.

At the time, my only model of electronic networking was the ARPANET, but that proved to be a good harbinger. Now we have a dozen other information utilities, with more coming all the time. We have the beginnings of electronic publishing, with companies like Softserv offering "paperless books." There are commercial information networks like Dialog. There is also BIX, which continues to amaze me: there are few questions I have seen (or asked myself) in my BIX conference that have not been answered, usually within hours. The information revolution continues at an ever more rapid pace.

I am not sure that we have given enough thought to the consequences of that revolution.

The Soviets Are Here

My most bizarre prediction was made in 1980, when I said that the small computer would, by the end of the millennium, bring down totalitarian Communism. The argument was simple enough: armies without sophisticated computing power would be unable to compete. All aspects of modern military power, from outer space to smart bombs to battle management to logistics to tank interception, depend on sophisticated technology, which itself depends on small computers for both its development and its deployment.

So long as the U.S. had even a marginally rational strategy of technology, the U.S.S.R. was faced with an intolerable dilemma: import or develop computing power, or give up all pretense of being a modern military power. Moreover, such computing power must be *distributed*; keeping a few great Hulking Giants under careful control isn't going to do the job.

As early as 1946, Arthur Koestler said that the sufficient condition for the destruction of totalitarian Communism would be the free exchange of ideas in the Soviet Empire. Distributed computing power automatically brings the free exchange of ideas. The small computer is the ultimate in *samizdat* (self-publishing) capability. It is literally impossible to prevent people with small computers from communicating with each other, nor is it possible to censor what kinds of information they exchange.

The result was glasnost; and that has come so far that ParaGraph, the joint

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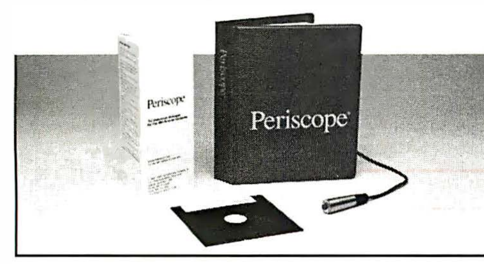
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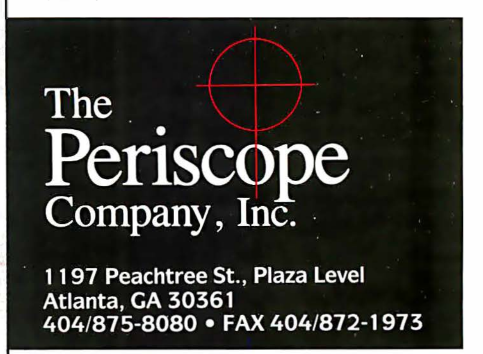
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venture of the U.S.S.R. and the U.S. that I described in the August issue, had a booth at Spring Comdex, the first attendance of a Soviet firm at a U.S. computer trade show. Two years ago, Soviet citizens coming to the U.S. had to stay in groups, and they were usually shepherded by large men in ill-fitting brown suits. No more.

ParaGraph was demonstrating their Cyrillization programs, which will automatically install Cyrillic characters and fonts into a number of word processing programs; if you write or publish in Cyrillic, call ParaGraph at (800) 872-8777 to get the details.

Incidentally, ParaGraph is not the only company with Cyrillic capability: Bob Wallace's successful shareware PC-Write Lite now has a Cyrillic module.

The Next Revolution

In the 15 years since BYTE was founded, we have seen incredible changes in the hardware available to us. The 486 I now have on my desk (under it, actually; it's in a tower configuration) has far more power than did the Hulking Giants of 1975. This trend hasn't stopped. Microcomputers will become increasingly powerful for lower and lower costs.

The microcomputer revolution has irretrievably changed the way we do business. It has brought glasnost, if not perestroika, to the U.S.S.R. (see my August column). The development of information networks and utilities continues apace. What remains?

I think the next great impact will be on the schools. Earlier this decade, a Presidential Commission on Education reported that "if a foreign government had imposed this system of education on the U.S., we would rightly consider it an act of war." Another report noted the similarity—in both organization and results—of the U.S. school system to the Soviet system of collectivized agriculture. Little to nothing has changed since those reports—indeed, in some places things are worse, not better.

On the other hand, the computer has had almost zero impact on American education. This is in part because there is no decent educational software, in part because we've yet to have really widespread distribution of small computers into the educational system, and in very large part due to the resistance of the educationist establishment, which fears these machines as the Soviet *nomenklatura* rightly feared the introduction of microcomputers into the U.S.S.R.

All this will change in the next decade. As I write this, IBM is announcing new emphasis on computers intended for the home and the schools, with introduction of new machines designed to compete in those markets. Commodore has come out with a new machine for home and school. The makers of Nintendo game systems have plans. Philips/Polygram continues development of Compact Disk Interactive drives. CDI will certainly have a major impact on the information revolution. And the installed base of the CD-ROM doubles each year as the price of CD-ROM drives falls.

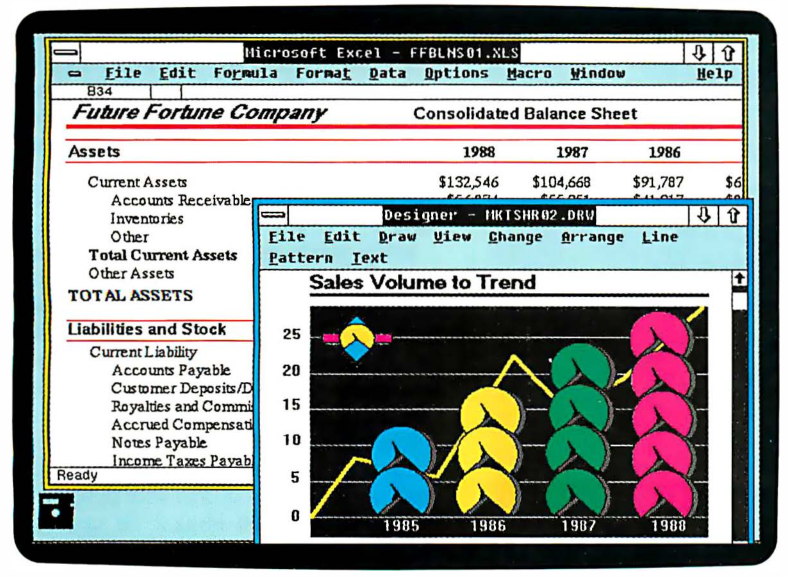
As the installed base of really powerful home computers grows without limit, the schools will be unable to resist bringing these machines into the classrooms. With such large market potentials, capital will be available to write and promote exciting new educational software.

Even more impact will come from the

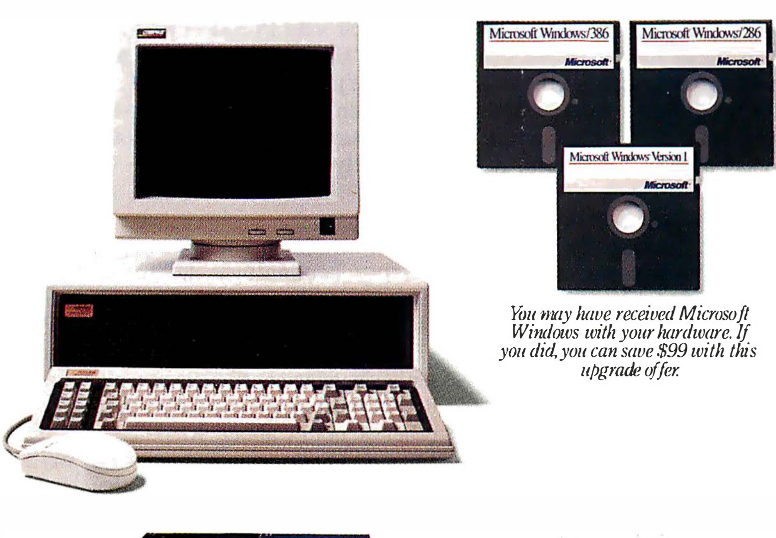
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development of new authoring tools. Owl International's Guide, Apple's HyperCard, Microsoft QuickBASIC, and other such programs will let the ordinary user develop sophisticated educational programs.

We'll have a lot of false starts. The centralists will try to dictate the form and content of educational software, and for a while they will succeed, as they have generally succeeded in controlling textbooks. But they will not be successful enough. Large U.S. corporations are already concerned that the schools aren't producing graduates with enough education to be put to work without extensive reeducation and training. Most companies remain snowed by educationist hype, but business by its very nature demands results; and there will come a time when business itself will, in self-defense, begin educating not only its employees, but their children.

I have earlier proposed that large corporations provide their employees not only day care, but on-site schools for their children; and that they demand that the teachers in these schools *get results*, not offer excuses for why the kids didn't learn anything. I think this will happen; and that these and other private schools will be a sufficient market for educational software that actually accomplishes something.

Meanwhile, many classroom teachers will despair of changing the system and will begin to make use of educational software that works. After all, most teachers don't want kids to fail. Many have been taught so many "diagnostics," which is to say excuses for failure, that they no longer expect the children to succeed; but most teachers hate that, and if they can be shown that there are methods that work, they'll adopt them.

It will be a long and difficult battle, as difficult as anything that has happened yet; but in my judgment, the small computer will bring decentralization—perestroika—to the American school system as surely as it has brought glasnost to the U.S.S.R.

The Real Hit of the Show

Normally, it's a bit hard to pick the most impressive item at Comdex: not only is there a lot to choose from, but there's no way to be sure that what they're demonstrating is real.

This time it was easy: a week before I came to Comdex, Larry Aldridge of Sterling Microsystems (3164 East La Palma, Suite K, Anaheim, CA 92806, (714) 632-7429) brought over the new Cheetah Gold 486. Larry puts together systems based on the Cheetah motherboard. The Gold 486 is itself one fantastic bit of hardware; and in it was the Perceptive Solutions, Inc. (PSI) hard disk drive controller.

The PSI Hyperstore 1600 card uses configuration modules to run as an MFM, RLL, ESDI, or SCSI controller; in the SCSI version, it will let you chain CD-ROM drives to the controller. Whatever configuration, this system is *fast*, blindingly fast, so fast I'd have suspected a trick if I hadn't been running this myself. Now understand, to get the kind of performance I'm getting, you need a superfast computer like the Cheetah Gold 486; hanging the PSI controller on your old AT will improve performance, of course, but you need a really hot machine to take full advantage of it.

When you have both, the result is little short of amazing. As an example, normally to run DataDesk Animator, you want to load the images into a RAM disk or into extended memory. With the PSI controller, you don't have to: this will run those images directly off the hard disk at any speed you'd ever want. It does it smoothly, with no jerks or glitches; indeed, the disk light blinks with perceptible pauses between blinks. Of course, the light isn't supposed to stay on; the PSI system uses all kinds of tricks with cache memory to anticipate what the program will need and be ready to provide it. As PSI Vice President Eric Lenington put it, "If that light stays on, we haven't done the job right."

I haven't had the PSI controller long, but I'd say the company has done the job heroically.

DPT

My Cheetah 386 has a Distributed Processing Technology (DPT) hard disk drive controller, which was the fastest controller we knew about back when Big Cheetah was put together. That controller has been in continuous use, 16 hours a day of hard usage and left turned on the other 8 hours about 90 percent of the time, and has performed extremely well.

Bill Godbout used to say that if the error rate is large enough to measure, it's too large; I feel the same way. In the past year plus that I've used the DPT controller with Big Cheetah, I've had precisely two incidents in which I got retry errors in reading or writing to the hard disk. In both cases I tried to get them to repeat, couldn't, and finally saved all my work and hit the Reset button just in case. My guess is that the problem had nothing to do with hardware at all, but was some clash resulting from multitasking under Desqview; and neither incident lost me any data.

In other words, the DPT controller has

been both very fast and very reliable for over a year, and I can unhesitatingly recommend the product.

I told the DPT people about the PSI controller's performance. They were aware of the company. DPT has not been standing still and has improved their controller since they sent me the one I use. The upshot is they'll send their newest, the PM3011/70, which I'll install in the Cheetah Gold 486; meanwhile, I'll put the Hyperstore 1600 into Big Cheetah. Then I'll run speed tests, so we can see just what performance is due to the computer and what's due to the controller. I should have that information next month.

Meanwhile, I love it when two really competent outfits compete to give us better performance; the whole industry benefits, especially when it's something as fundamental as a hard disk drive controller. Stay tuned.

New Speed Tests

Everyone has system and disk speed tests. The BYTE Lab has one you can get copies of. So do most other magazines. I even devised one myself: filling two matrices, multiplying them together, and summing the elements of the result. Mine had the advantage of doing a lot of both floating-point and integral arithmetic.

For disk speed tests, I tend to use the Coretest utility; this gives you a lot of information and compares your machine with a number of "standard" machines. The Coretest index is based on both data transfer rate and seek times, and people I trust say it's the best speed index there is (see table 1).

For general speed testing, I've tended to use my matrix test, but in fact I got away from doing that during the past year or so.

At Comdex, Robert Hurt handed me yet one more system test. I've known Hurt for some time, and I tend to respect his judgment. Anyway, it's called the Landmark System Speed Test and is distributed by Hurt's Landmark Research International. They needed it: they were demonstrating what they called "the fastest computer in the world," to wit, a 486 jacked up to 44 MHz. The chip was cooled by a gadget known as Icecap, which stands about 4 inches tall—they had to saw away part of the disk bay to get it into the machine—and has some kind of active refrigeration.

The Landmark test's great merit is that you can't peg the meter: it will measure computer speeds beyond anything we're likely to have in this century. Incidentally, Landmark has some other neat stuff, including a kit for cleaning, testing, and aligning floppy disk drives; write for their flier. Core International makes disk systems as well as the test program.

It's hard to tell just how accurate the Landmark test is, but I've just tried it on nearly every machine in the house, and it seems to work just fine; certainly the results are about what you'd expect (see table 2).

It also shows the very respectable performance of the Premier 9000, and the truly awesome speed of the Cheetah Gold 486 with the Hyperstore 1600 controller.

DR DOS

I'm often credited with making CP/M the standard back in S-100 days. True or not, I've always had a soft spot in my heart for Digital Research; the full story of why the company didn't make a deal with IBM—and how Seattle Engineering got its first DOS, which it sold to Microsoft—hasn't yet been told in print. Perhaps one day I will.

I've been experimenting with a beta version of DR DOS 5.0; this version works with Microsoft Windows 3.0, although I understand that Microsoft tried a number of tricks to prevent that. What it *doesn't* work with is the new Cheetah Gold 486. "Timing problems," I'm told, that will be fixed Real Soon Now.

In fact I rather hope so, because there are good features in DR DOS. DR DOS's main claim to fame is *enormous* temporary program areas; we were getting as much as 639K bytes of free memory with VGA! (It would be 1K byte larger—yes, 640K bytes of free RAM—but the Hyperstore 1600 uses 1K byte out of main memory.) It's said to work with Desqview.

It has a number of features MS-DOS doesn't have or doesn't do well. It also comes with a quite competent 386 memory management program, standard, that claims "VCPI compatibility"—meaning that programs that use extended memory, such as Lotus 1-2-3, AutoCAD, and Mathematica, can run directly.

I'd sure like for DR DOS to be a success, if only to give Microsoft some competition: look how much better QuickBASIC got when Borland came out with Turbo Basic.

Alas, we've run into problems. We can't make their 386 memory manager work with AutoCAD; nor will QEMM-386 5.0 behave properly with DR DOS. Desqview runs only with no memory manager installed at all.

I want DR DOS to work, but it's not quite there yet. However, when I sent a draft of this column to Digital Research,

continued

CORETEST RESULTS

Table 1: *The Coretest measures the performance of a computer based on the data throughput of its hard disk drive system.*

Machine/ controller	Data transfer (KB/sec)	Average seek (ms)	Track-to-track seek (ms)	Performance index
Cheetah 486/ PSI	1519.5	0.3	0.7	223.7
Cheetah 386/ DPT	620.2	1.4	1.1	42.0
Premier 9000	788.8	15.1	2.8	8.3
IBM PS/2 80 (70-MB)	800.0	36.0	15.0	6.3
Compaq 386/20	375.0	26.0	4.0	4.3
Kaypro 386/ Perstor	159.8	25.2	3.9	3.1
Zenith Z-248	241.7	31.8	6.7	3.2
IBM XT (10-MB)	85.0	79.0	31.0	1.2

LANDMARK SYSTEM SPEED TEST RESULTS

Table 2: *The Landmark System Speed Test rates the computers in megahertz relative to an IBM AT running at 6 MHz with an 80287 math coprocessor.*

Machine	CPU (MHz)	FPU (MHz)	Video (characters/ms)
Cheetah 486	82	196.0	1321[1]
Premier 9000 (386)	49	N/A	1321[1]
Cheetah 386	22	44.0	892[2]
Goldstar 386	19	N/A	1962[3]
Kaypro 386	15	15.7	774[4]
Zenith Z-248 (286)	10	5.3	473[4]

[1] Tseng Laboratories video chip.
[2] Video Seven.
[3] Paradise Systems Super VGA.
[4] EGA.

it sparked a flurry of activity; we now have a DR DOS that appears to work with 386 machines; and they're working on the 486 version. More next month, but it looks as if they are moving on this.

Ad Lib Visual Composer

I am not musical. I can't sing, I don't play any instruments, and I can't read music. However, Mrs. Roberta Pournelle was a music major in college and has sung professionally; the result is that I'm a founder member of the Los Angeles Opera Association, and we go to all the opening nights.

Despite not being musical, I've always liked what's usually called "classical music," and since what I grew up to regard as "popular music" no longer exists except as "golden oldies," I tend to keep my radio fixed on KUSC, the local good-music station. I have, therefore, developed some store of knowledge about classical opera. I've also learned to hate most modern opera. As for minimalism, as KUSC's Jim Sveda says, common sense tells you there isn't much there, even if politeness makes us pretend there is.

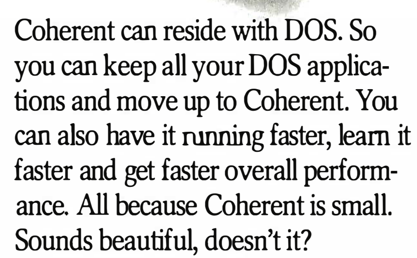
It was with some trepidation, therefore, that I went to the world premiere of two "fantastic" modern operas based on the children's books by Maurice Sendak: *Higglety Pigglety Pop!* and *Where the Wild Things Are.* In fact, they were quite interesting: the staging was excellent, the actors were good, the costuming was superb.

The only problem was the music by Oliver Knussen: there wasn't much, and certainly there were no arias; in fact, there wasn't a bar of it that couldn't have been something else.

I'd be willing to bet that with the possible exception of the conductor, no one hearing the same opera again with similar but different music would know the difference—with the possible exception of a very irritating repetitive atonal line always ending in the word *hot* sung in a

continued

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falsetto rising tone. So it goes.

But it got me to thinking. I recently installed the Ad Lib Synthesizer Card in the Cheetah Gold 486. I confess I did that largely for games: many games now use the Ad Lib sound system. The Railroad Tycoon game sounds great with the Ad Lib system. The card doesn't require any software overhead, so except for using up a slot, it's no problem to have it there; and adding it gives your PC about the same sound capability as the Mac.

The Ad Lib card came with the Visual Composer program. This, it turns out, is extremely easy to use: when you invoke it, the program comes up with a display of a piano keyboard over on the left. Click on a key, and it plays. You can also click in the grid-lined space out to the right of the keys, and any notes put there will play when you tell the program to play your "tune."

You can put in notes in the "first voice," adjust them until you like them, and then add the "second voice." Notes put in that voice will play simultaneously with those in first, but nothing you do in second voice mode will affect first voice. When you have those two right, you can add a third—up to 11 voices, each independently editable. You can play any single voice, or all at once. There is also a whole bunch of preset instrument sounds you can add.

When we got back from the opera, I put up Visual Composer and began noodling around. The results are a bit weird, but I like it better than what I heard at the Music Center. I've heard that the opera *Holy Blood and Crescent Moon* was written on a computer by a man who doesn't read music. Maybe I'll be able to do something of the sort. As a writer, I should be able to do my own libretto. I suppose if I do attempt an opera, I'll need the MIDI Supplement, which lets you attach a MIDI device, play on that, and record the result. I'll also need Instrument Maker, which lets you create new instrumental sounds.

The program will copy, cut, paste, and transpose. The notation is *not* standard music notation, and if there's a way to get it to print in standard notation, I haven't found it. This is a severe limit to using it for professional work.

There are better programs for the Atari ST and the Amiga that really do print out in standard music notation, but the Ad Lib card and program are a start. I know you can do some pretty good music for it, because many games now have tunes as well as sound effects. I would be willing to bet that in five years there won't be many PCs without really good sound capability.

Incidentally, I play the Ad Lib music through a $25 set of battery-powered amplified speakers I got at Radio Shack; I can also input it into my stereo system. Either works fine.

LANtastic

Artisoft started off as a tiny little outfit at Comdex with a display out in the periphery; now their booth is right near the BYTE booth, which shows there's some justice in the world, because Artisoft's LANtastic is one neat product (see "Networks of Peers," June BYTE).

My friend Greg Bear, retiring president of Science Fiction Writers of America (I can say from experience that retiring from *that* job is one heck of a relief), uses LANtastic in an unusual way. He has a 286 machine set up as a server: it has a backup hard disk drive, an Amdek Laserdek CD-ROM drive, and some other stuff. This links with LANtastic to his 386 system running Windows/386. In one window of that, he has the CD-ROM with Microsoft Bookshelf running underneath WordPerfect 5.1. The window has to be 544K bytes in size; anything smaller would crash. Fortunately, LANtastic takes up only about 16K bytes of regular RAM; the rest is stuffed up into extended memory. With Windows/386, you can just manage.

I intend to set up my system that way, with two Denon CD-ROM drives, the Maximum Storage WORM (write once, read many times) drive, and a Bernoulli Box on a 386 clone server; the whole mess will link with the Cheetah Gold 486 through LANtastic. While I'm at it, I'll set up Mrs. Pournelle and John Carr with LANtastic networking capability as well. The only reason I haven't done it yet is that I'm still experimenting with DR DOS; pretty soon I'll decide whether to keep that or dump it, and I can get to work. Whether I'll use Windows or Desqview isn't yet decided.

LANtastic is available either as coaxial connected Ethernet or in the older 2-megabit-per-second twisted-pair configuration. It's a true peer-to-peer network—no net server required, so my designation of the "service machine" as a "server" isn't really correct. They've recently greatly improved the installation procedure so that it's understandable for ordinary people. They have also added speech-synthesizer capabilities: you can now telephone over LANtastic and leave a message in your own voice. They're working on a program that will let you program speech synthesis as well, but

continued

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that's not out yet.

One reason, perhaps, that LANtastic hasn't received more notice is that *it just works*. Unlike Novell networking, which literally requires thousands of dollars of schooling to sell, LANtastic is simple and easy to use. True, Novell has many sophisticated features, like security and internetworking, but most people don't need them.

If you need an inexpensive peer-to-peer network, LANtastic is the clear choice. It gets a well-deserved Chaos Manor User's Award. Recommended.

Winding Down

I'm out of space, and I haven't had a chance to talk about the USVideo TVGA Video Card, which allows us to run Mrs. Pournelle's Reading Program, mix in a camcorder video of her explaining it all, and put the whole thing on videocassette. This is one of the most exciting things that we've done recently.

The game of the month is Microprose Software's Railroad Tycoon; I'd hate to tell you how much time I've wasted with that. If you ever liked to play with trains, you will *love* this.

One of the most interesting programs this month is HyperMap from Cognivision Research. This makes visual databases on an EGA or VGA system.

The book of the month is by Geoffrey Hosking, *The Awakening of the Soviet Union* (Harvard University Press). The computer book of the month is by Douglas W. Nance, *Fundamentals of Pascal* (West Publishing); mirabile dictu, a *readable* introductory textbook that's both systematic and thorough.

Next month, a whole bunch of stuff on Windows 3.0 and Desqview. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

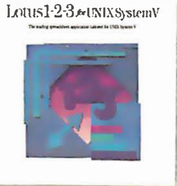
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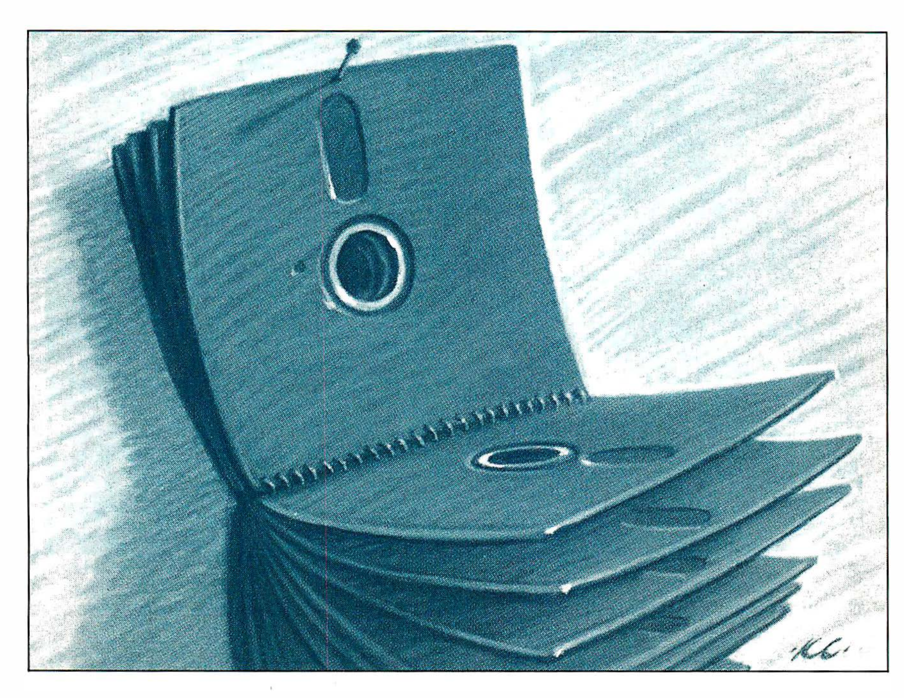
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FUTURE HISTORY

Who says there is no Unix business software?



There are many great myths in the computer industry, like "With just a minor modification to this software, our computer will run your entire business." One I hear a lot is, "There aren't any good business applications available yet on Unix." And yet there are almost 400 *pages* of application programs listed in UniForum's 1990 Unix Products Directory.

I'm not going to reveal a secret conspiracy involving evil DOS software vendors bribing computer tabloid writers. There aren't any. Neither will I recite the litany of reasons why this unfortunate state of affairs *did* occur. And, in spite of the growing popularity of this column, I'm under no illusions: Misconceptions and prejudices of this magnitude don't go away after being exposed to logic.

Without getting on any soapboxes, though, I'd like to make sure the facts are clear. There are at least a dozen Unix spreadsheets and even more word processors. Accounting packages and DBMS platforms abound. There are many personnel, sales, project management, and office-automation programs.

And then there are vertical market packages. If your company is involved in farming, construction, medicine, retail sales, law, finance, real estate, manufacturing, insurance, or a host of other industries and professions, there are many packages to choose from. Do you run a bank? Perhaps a blood bank? A speakers' bureau? A funeral home? Are you a yacht broker? An importer? Do you sell off-road accessories? Lumber? There are packages for all these and more.

Enough already. The point is that Unix applications do exist, and the main reason they do is, clearly, that companies are using Unix in the real world. After all, how much difference is there between typing "123" under DOS and typing "123" under Unix?

And if that's not good enough, there are over 70 windowing and menu packages available that you can use for friendly front ends.

Let's See What Develops

Even with all the applications available now, there's plenty of room for more, especially better ones. I know there are many developers reading this column, so here's some free advice, guaranteed to be worth at least what you paid for it.

Look at the rapid growth in several technology areas: high-performance CPUs (both RISC and more traditional designs, such as the i486), high-resolution graphics (Super VGA and 8514/A on the IBM PC end, and low-cost workstations on the other end), digital signal processors, and homogeneous networks. The end result is surely going to be high-performance interconnected workstations with video and audio I/O. The key here is that things will have to be standardized at some level so that they will all work together.

From the software end, you want to be developing on one of two main fronts. Users will demand applications that are not only intuitive (from a *real* user's point of view), but work intelligently and invisibly with whatever resources are available. In other words, the application should automatically find and use things like color graphics, a mouse, voice I/O, network connections, and printers. It shouldn't require a guru to install or a supervisor to type chmod commands.

The other way to succeed is to make the glue that holds all this together. Develop a program that can locate resources across a network, for instance. Write a universal driver for a pop-up window.

continued

ILLUSTRATION: KEN CONDON © 1990

Figure out a way to wrap applications software in a self-installing package so you don't need that guru. Develop software that makes network administration easier. Invent an expert system that will generate optimally intuitive software. Then sell all this stuff to the developer in the previous paragraph.

Daze of Future Past

It's certainly hard to believe that 15 years have passed since I saw my first issue of BYTE. Fifteen years is an appreciable period of time in anyone's life, and it is several generations in the computer industry, of which even Unix is but one small part.

In 1975, Unix was already six years old, but it had still been ported only to Digital Equipment architecture, and it had just been rewritten in C (from assembly language) two years before. Computer scientists outside Bell Labs had learned of the existence of Unix a little over a year before that, with the publication of the paper *The Unix Time-Sharing System* by Dennis Ritchie and Ken Thompson in the *Communications of the ACM.* And the first "modern" revision of Unix, called version 6, was still about a year away.

Without gazing nostalgically at the past too long, I think it's important to realize how far Unix has come before I talk about where it is going. Those who have been involved almost exclusively with Unix have seen it grow into a major force in the industry. Yet, until quite recently, Unix has not had much impact on the public, compared to, say, hardware products such as the IBM PC and the Apple Macintosh.

On the other hand, how many software products are still around, let alone growing as fast as Unix, 20 years after their introduction? This in spite of the confusion created by the relatively large number of revisions and semicompatible versions of Unix that have existed at just about every moment of its life span.

A Patch of Blue Sky

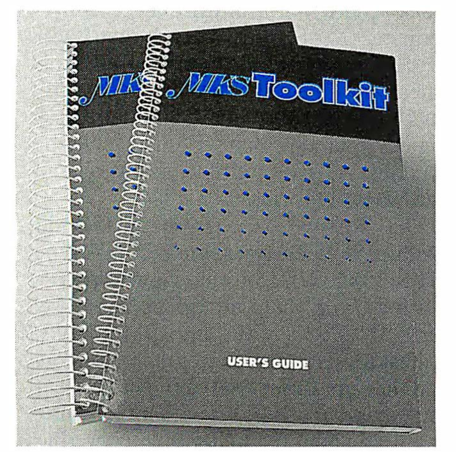
The next 15 years is almost too far ahead to predict, at least in terms of the computer industry. It seems clear, however, that Unix itself will cease to be a major issue, just as "to C or not to C" is no longer the question for many software developers. After all, how many other technical issues do manufacturers as diverse as Apple, AT&T, Compaq, Cray, Data General, DEC, IBM, and Sun agree on? Even now, people are starting to use the term "open systems" to avoid being associated with Unix exclusively; yet "open systems" is little more than a euphemism for "Unix and Ethernet."

In the years to come, Unix—or whatever name the megaconsortia of the future give it—will be the core of a company's information resource network (except for those companies too small to have more than one computer). Whether the users deal with Unix directly (which I think is unlikely) or with a front end, such as a graphical user interface (GUI), is a moot point; Unix will someday be as ubiquitous as microprocessors are today. The reason has nothing to do with its many benefits to developers. It is simply that there's no other nonproprietary system that supports multiple hardware platforms, not to mention networking and other standards. Users and developers have agreed that it's the training and support costs that make or break software, and a common standard for all types of computers—not just Intel-based ones—is

continued

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MKS Toolkit reflects its users' needs. Organizations such as AT&T, H-P, ITT, and NCR - all heavily committed to the UNIX system - use MKS Toolkit to create a standard operating environment. Universities, from Harvard to UCLA, use MKS Toolkit to enrich personal research computing environments and double the bandwidth of their PC teaching labs. The National Institute of Standards and Technology uses MKS Toolkit as a standard operating environment for experts and as a POSIX training tool for neophytes.

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What you think of now as DOS will be no more than a front end for Unix. That's happening now, with interface products from companies such as Locus and Visionware. There's no reason to kick people out of a familiar operating environment, but there's equally no reason to keep your firm in the dark ages of data processing by not sharing data and resources.

A Real Product

Of more concern to users will be what I call the Graphical Operating System Hack (GOSH) or Multimedia User Environment (MUSE)—two terms that I will be glad to donate to the public domain. These are what today are known as GUIs but will evolve into intelligent multitasking environments that will themselves be available across multiple software and hardware platforms.

IXI Software's current X.desktop product is an early example of this type of thinking. While it was originally written for Unix, there are ports under way for both DEC's VMS and IBM's MVS. X.desktop is a complete graphical front end that lets a user deal with files, directories, and applications without knowing anything about the underlying operating system. It's a perfect analogy to Unix, which was designed to let a user or programmer deal with files, directories, and applications without knowing anything about the underlying hardware. When was the last time you, as a user, cared about hexadecimal load points? Yet many computer users routinely dealt with such problems not very long ago.

Of course, the technical developments occuring even now make it obvious that your GOSH- or MUSE-based workstation of the future will have audio and video extensions that will greatly increase the complexity, if not the usefulness, of current hardware and software. After the dust of new standard-making settles, though, you'll finally have computers that will do more of what people really need them for. Just wait till you see MegaRogue Turbo Plus, with live dragons! ■

David Fiedler is executive producer of Unix Video Quarterly *and coauthor of the book* Unix System Administration. *He has helped start several Unix-related publications. You can reach him on BIX as "fiedler."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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THE PLACE TO BE FOR DTP

Is the Mac really the best machine for desktop publishing?



In my line of work, I occasionally use desktop publishing (DTP) software to produce some pretty basic camera-ready items—stationery and business cards for my consulting company, an occasional flier or short brochure for my university department, that sort of thing. But I'm no pro, that's for sure.

Imagine my surprise when I found out that I was supposed to talk about the hottest DTP tips at the recent MacWorld Expo. Well, I'm a member of the Expo's advisory board, so I wanted to give it my best shot. For me, it meant getting to know DTP from the point of view of the pros who live that life every day. Along the way, I found out something very interesting: The Macintosh's reputation as the microcomputer of choice for DTP work is well deserved.

Surprising Facts

First, most of the professional desktop publishers I talked with weren't ardent MacFolk. This surprised me, as I expected just the opposite. But the dozen or so people I worked with in Chicago, Boston, San Francisco, and Cupertino were not in that league. They use the Mac for their DTP work because it suits their work flow the best. They've tried other systems, including high-end 386 and 486 machines running DOS and Windows or OS/2 along with PageMaker or Ventura Publisher; several have also tried a Sun SPARCstation and a NeXT Computer, both running Unix and FrameMaker.

The overall consensus was that the Mac is the best compromise of performance, an easily learned interface, expandability, known value, and reliability. These desktop publishers also mentioned the ease with which they can sell or upgrade an older Mac to get a high-powered Mac IIci or IIfx. The Mac *is* the machine of choice for people in this type of work.

What I next learned startled me. It's the software, not the Mac's WYSIWYG display, that first got their interest. Another surprise: It wasn't page-layout software like PageMaker, but high-resolution drawing software that won them over. Virtually all the desktop publishers I consulted have commercial art backgrounds, so they understand color and graphical elements better than I do.

The raft of good monochrome and color drawing programs for the Mac (e.g., Illustrator, FreeHand, PixelPaint Professional, MacDraw II, ImageStudio, and Cricket Draw) convinced them that the Mac is the place to be for DTP. They all mentioned that DOS, Windows, and OS/2 machines (or Unix workstations) couldn't come close to the array of specialized drawing software on the Mac.

Less Surprising Facts

Finally, though, I started to validate a few things I expected (whew!). PageMaker is the most popular page-layout program for DTP, but Quark XPress is close behind. PageMaker 4.0 excels at flowing text, and its typographic features (e.g., hyphenation, kerning, and leading) are much improved over version 3.0. It also includes a useful Story Editor that most of these desktop publishers believe is a huge improvement over the largely nonexistent editing tools in 3.0.

According to these experts, Quark XPress provides more features than PageMaker does, but it's also harder to use. However, Quark XPress does four-color separations with aplomb, and its graphical placement capabilities and typographic features are more accurate

continued

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than PageMaker's. That's why they use PageMaker for longer, less critical publications, while Quark XPress is reserved for smaller, snazzier pieces.

I was also reminded of the kinds of damage that page-layout programs can do in the hands of inexperienced users. Each of my DTP friends showed me some "publications"—done by novices—they had been asked to "fix."

Conclusion: Mac page-layout programs can produce high-quality documents in the hands of experienced users. But that's also their biggest collective weakness.

To use one of these systems, you have to already know a lot about how a finished publication is supposed to look and how it gets to that finished stage. You need to know how graphical elements (i.e., photos, charts, tables, and the other visual devices) should be placed, how text should be flowed around your graphical elements, how much white space should appear between characters and lines, and what "feeling" the whole document is trying to give you.

The Mac has made a generation of computer users literate in the basic two-dimensional ways of graphics-based desktop computing. The problem is that publications aren't really 2-D entities. They have a pseudo "third dimension" operating all the time, even if it's just text on a page. A well-designed publication draws you into it, as if it were a 3-D environment that you could wrap around yourself. A poorly designed publication draws you nowhere; it leaves you flat and doesn't immerse you in its alternate universe. If you think I'm overstating this effect, think back to the time you read that *really* good book.

The problem is that the Mac makes all its users think that they can do anything, as long as they have the proper software. You say you need to create a four-color glossy recruiting publication for your company? Punch up Word, PageMaker, and FreeHand, and you're on your way. You've got the Mac behind you. You can do anything. It's the power to be your best.

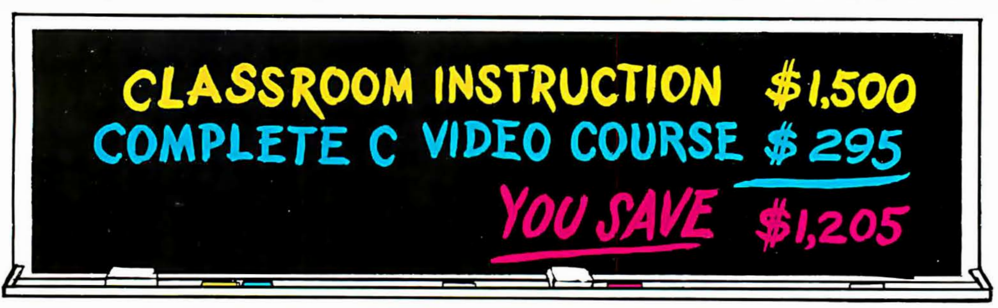
That's the problem. While the Mac can be a powerful computing engine, it can't make you a subject matter expert—or at least not overnight. The Mac does such a good job of taking us over the start-up learning hump that we forget about that niggling little problem of subject matter expertise.

There are worse problems to have in the realm of personal computing, I think. Like the problem of getting started

continued

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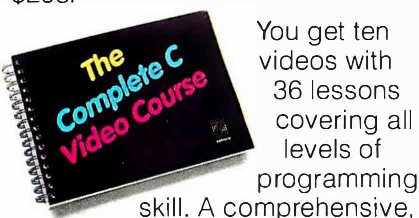
Unfortunately, learning C can be a very costly proposition. Classroom instruction is, in a word, expensive. And many C video courses carry hefty price tags.

```
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#define NUMMARK 4
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{
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  int mark[NUMMARK];
};
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in the first place. Pretenders to the Mac throne should keep that in mind as they try to duplicate and exceed the machine that put the personal into personal computing and windows on desktop computers everywhere.

Windows 3.0—An 85 Percent Mac?
This, of course, brings me to Microsoft Windows 3.0. I beta-tested this baby and now use the release version. Of all the windowing systems that have tried to beat the Mac at its own game, Windows 3.0 is the first one that could really do it. OS/2, while much improved, still seems bloated for what it does.

Compared to OS/2, Windows 3.0 seems almost lean. It will even run on a 640K-byte XT! Also, it automatically configures to your hardware on start-up—getting the most functionality out of an 8086-, 286-, or 386-based system with 1 megabyte of RAM, and a 386-based system with more than a megabyte of extended RAM. If you want to know more about Windows 3.0, see Jon Udell's excellent First Impression "Three's the One" in the June BYTE. My bottom line is simple. Windows 3.0 gives you about 85 percent of a Mac on almost any kind of PC, and that could be enough to induce Mac software developers to look at IBM platforms lovingly.

Tip of the Month: On Location
Mitch Kapor is one of the really bright guys in the computer business. Founder of Lotus Development, Kapor now heads a small start-up company called On Technology. Its first product, a desk accessory (DA) called On Location, portends good things for the company.

On Location lists for $129.95, which is much too high for what it does. It provides an active index of files and file contents on your disks that can be searched at high speed. You can get much of what On Location does in other DAs and utilities, including CE Software's excellent DiskTop, but On Location is arguably faster and easier to handle. But it's also buggier.

I have been using version 1.0 since March, and I like it. But I don't like the fact that I've had to recreate the indexes at least a dozen times because of a repeating "This index is damaged" problem. This is especially troublesome, since it takes On Location over an hour to index a big disk. It takes about 2½ hours to do a Jasmine DirectDrive 180 of mine that holds 170 MB in 9200 files, and that's on a processor-cached 8-MB Mac IIci. On slower Macs, the indexing performance is even slower. Once the indexes are created, the searches are done in real time, and blindingly fast, even on less prodigious iron than the IIci.

On Location also has intermittent start-up trouble with some shareware INITs, especially SuperClock, and with Icom Simulations' On Cue menu-bar application launcher. For what On Location costs, and considering that it's the company's only product, On Technology needs to get version 1.1 out quickly, with a large dollop of robustness added. Dropping the list price to $75 wouldn't hurt, either. ■

ITEMS DISCUSSED

DiskTop $99.95
CE Software, Inc.
1854 Fuller Rd.
P.O. Box 65580
West Des Moines, IA 50265
(515) 224-1995
Inquiry 981.

On Cue 1.3 .... $59.95
Icom Simulations, Inc.
648 South Wheeling Rd.
Wheeling, IL 60090
(708) 520-4440
Inquiry 982.

On Location 1.0 .... $129.95
On Technology, Inc.
One Cambridge Center
Cambridge, MA 02142
(617) 225-2545
Inquiry 983.

PageMaker 4.0 .... $795
upgrade from 3.x $150
Aldus Corp.
411 First Ave. S
Seattle, WA 98104
(206) 622-5500
Inquiry 984.

Quark XPress 3.0 .... $795
Quark, Inc.
300 South Jackson St., Suite 100
Denver, CO 80209
(303) 934-2211
Inquiry 985.

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

TOOLS '91

Technology of Object-Oriented Languages and Systems

International Conference & Exhibition
CNIT Paris (La Défense), March 4-8, 1991

FIRST ANNOUNCEMENT AND CALL FOR PAPERS

Program Chairman: Jean Bézivin, Conference Chairman: Bertrand Meyer

TOOLS '91 will continue the tradition of excellence and practicality which have established TOOLS as the major international conference devoted to the practice of object-oriented programming. TOOLS '91 will include tutorials, workshops, invited presentations, submitted papers, and an exhibition of industrial and research object-oriented tools.

The conference format will include:

- ❑ **Tutorials** (on March 4-5) addressing major topics in the field of object-oriented methods, languages, tools and applications.
- ❑ **Invited presentations** by international object-oriented experts.
- ❑ **Submitted papers** on important practical aspects of object-oriented techniques.
- ❑ **An industrial exhibition** of object-oriented tools, languages, environments, databases and their applications.

The conference will once again be held in the exciting new CNIT center in Paris (La Défense), a business and conference center devoted entirely to technologies of the future.

SUBMITTING A PAPER

TOOLS '91 is now soliciting papers on all aspects of object-oriented technology. All submitted papers should have a strong practical bent and emphasize applications. A non-exhaustive list of suggested topics includes:

- ❑ Reports of actual experiences with object-oriented tools and methods.
- ❑ New developments in the technology.
- ❑ Development and use of reusable component libraries.
- ❑ Management and educational issues.

If you intend to submit a paper, check the appropriate box on the coupon below to receive a copy of the *Guidelines for Authors* and maximize your chances of acceptance. Submissions may be made in the form of either full papers (8 to 15 single-spaced paged) or extended abstracts (5 or more pages including basic bibliography). Submissions will be evaluated by the International Program Committee, chaired by Professor Jean Bézivin of the University of Nantes. Six copies of each submission should be sent to:

TOOLS '91
Attn: Jean Bézivin
Laboratoire d'Informatique
Faculté des Sciences et Techniques
Université de Nantes
2, rue de la Houssinière
44072 Nantes Cedex - France

IMPORTANT DATES

All submissions must be received by November 1, 1990 to be considered for inclusion in the conference. Submissions should be in English. Notification of acceptance will be mailed by December 15; final manuscripts will be due January 15.

THE INTERNATIONAL OBJECT-ORIENTED WEEK

One of the most exciting parts of TOOLS is the International Object-Oriented Programming Week, a set of meetings on topics related to the theme of TOOLS. Friday, March 8 has been set aside for independently organized events, such as User Group meetings or standardization committees.

The TOOLS '91 organizers will help coordinate such events if they fall within the scope of object-oriented techniques, and will include the announcements in the final TOOLS program. If you are interested in setting up such a meeting, please contact TOOLS '91 for details at the Paris or Goleta address below.

Electronic Mail:
uunet!geocub.greco-prog.fr!bezivin (from the US)
geocub.greco-prog.fr!bezivin (from Europe)

NOTE: Tools Pacific. A special edition of the TOOLS conference will be held in Sydney (Australia) during the last week of November 1990, to reflect the growing activity of the object-oriented field in the Pacific Area. For Information, please contact Myriam Wever, 8 Jane Street, Balmain, NSW 2041 Australia. FAX +61-2-810-3726 or one of the addresses below.

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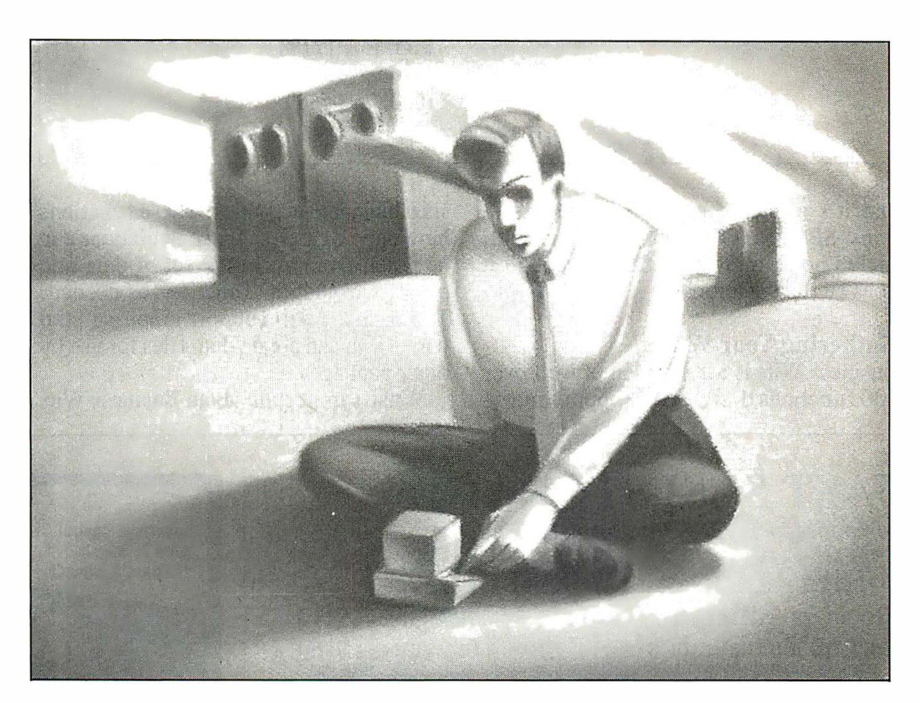
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MOVING DOWN TO MICROS

Mainframe-quality decision-support systems are beginning to appear on microcomputers



Throughout the years of growth in the microcomputer industry, a great variety of applications have moved from the world of the mainframe to the world of the microcomputer. A few major areas began with small computers and moved to their larger cousins. There have, however, been some classes of applications that have resisted moving, because of their size and complexity or because of the number of users that they must support. Those areas include large databases and decision-support systems (DSSes); now it appears that they will move to microcomputers as well.

I discussed the role of Structured Query Language database servers last year (see the November 1989 BYTE), and that move of the SQL database functions from the mainframe to the microcomputer-based LAN continues. In what may be an even more important move, mainframe-quality DSSes are beginning to appear on microcomputers. While this trend is new, it's also clear that the move will be inexorable. The reason is cost.

What's a DSS?

To explain why cost is such a factor, I'll look at what a DSS really is. While, in the broad sense, a DSS is any software that allows you to see information in a way that helps you make a decision, the term is normally used in a more restrictive sense. In the past, DSSes have been taken to mean large, complex financial or mathematical modeling software that will support a wide variety of queries with a great deal of flexibility. Now that they are moving to microcomputers, of course, they mean the same thing.

Over the years, DSSes have been so important to large corporations and agencies that companies have been willing to purchase and support mainframe computers dedicated to them. Despite the hundreds of thousands or millions of dollars involved, the ability to perform the complex modeling was profitable.

Many DSSes were custom software, designed specifically for the organizations that they were to support. While some still are custom systems, now there are also commercial DSS packages available in the mainframe and minicomputer worlds, and they are very popular. These packages enable users to link standard modeling functions in such a way that verified functions can take information, pass it from one function to the other, and produce a result or group of results.

You can, for example, project financial performance for a year for an entire business or division. You can also project or analyze such diverse business characteristics as production-line performance or the effect of foreign currency changes on profitability.

Micro DSS Packages

Two packages have arrived on the market that attempt to bring the power of the mainframe DSS to the desktop. As you might expect given their ancestry, both are massive, complex, and enormously powerful. They are also unlike nearly anything else in the industry. Using them is not a trivial matter—but then, the results they produce and the importance to the businesses that use them are not trivial, either.

Business Wits is the initial product offering from Decisus, a new subsidiary of the Xerox Corp. From its introduction, Business Wits has been billed as a DSS,

continued

ITEMS DISCUSSED

Business Wits....................$695
Advanced Financial Applications...................$195
Banking and Investment Applications...................$195
Statistics and Sampling Applications...................$195
Decisus, Inc.
9938 Via Pasar, Suite A
San Diego, CA 92126
(800) 433-0307
Inquiry 1101.

SPSS for OS/2...................$995
SPSS Advanced Statistics for OS/2.............................$495
SPSS Tables for OS/2..........$495
SPSS Trends for OS/2.........$495
SPSS, Inc.
444 North Michigan Ave.
Chicago, IL 60611
(312) 329-3500
Inquiry 1102.

Stats...............................$475
KnowWare
P.O. Box 17788
Boulder, CO 80308
(800) 759-5669
Inquiry 1103.

and it's a classic example of such systems. SPSS for OS/2, on the other hand, makes no claim to be a DSS, although it does fit the definition.

Gathering Your Wits

Business Wits is a collection of well over 100 functions designed to support analysis of business activities. These functions have been written so that calculations can be taken from an initial set of data and passed through the functions as needed. The package will support graphing, and with it you can create data files for use by other packages.

What's important about Business Wits is that the standard functions have been chosen specifically for use in a DSS. The specific choice of functions means that the software will perform a wide variety of interest calculations, but it's tough to use it to find the amount of your next car payment. Of course, it's not designed for that. Instead, Business Wits uses calculations to support projections such as the present value of future payments, or to figure such a value in terms of foreign currency fluctuations.

The hundreds of functions that come with Business Wits are designed so that they can't be changed by the end user. Decisus had each function validated for correctness and conformity with generally accepted accounting standards; allowing changes would make the validation meaningless. But if you need a function that Business Wits doesn't support, you can create it.

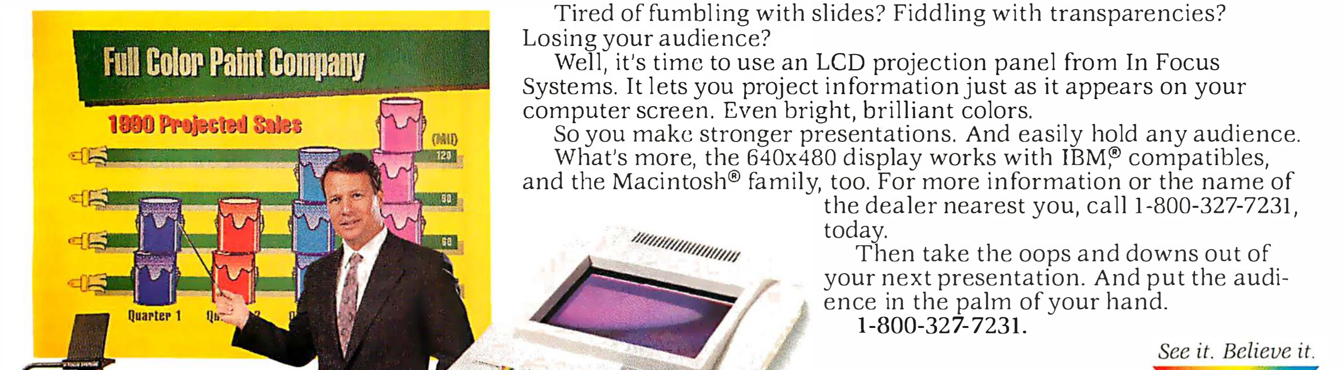
Number Crunching

SPSS for OS/2 is the desktop version of a successful DSS already in use on mainframes and minicomputers. The software requires OS/2 1.1 or higher, and it

continued

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supports Presentation Manager (PM) but will also work without it. SPSS performs various statistical and numerical analysis functions, and it lets the functions start with given information and pass the results through a series of processes to produce a result.

The only way to describe SPSS is that it's truly massive. The base system and the add-on libraries require that you have at least 4 megabytes of memory and 15 MB of available hard disk space. The system will run better if you have more memory and a math coprocessor. These machine resources are similar to what you'd find on a minicomputer running the same application.

Despite its mainframe heritage, SPSS takes advantage of PM's graphical user interface, and you can use your mouse to select commands that will build the command file that actually analyzes your data. If you aren't one of those who delight in typing in commands from memory, the PM support makes SPSS accessible.

Learning Curve

Both of these DSSes are complex systems, and they require that the user have some knowledge of the subject. You will never be able to use Business Wits successfully, for example, if you don't understand at least the basics of business math and finance. You will be able to use the software, but you won't be able to produce meaningful results. The same concept applies to SPSS: Unless you understand mathematical analysis and statistics, you'll get little benefit from this package.

In addition, both packages are sufficiently complex that they require you to have some training to be really useful. The user interfaces are well designed, and even the rank beginner can produce output, but you must have training in the use of the systems to take advantage of their power. In this way, they are like their mainframe cousins. The immense power and flexibility, though, mean that you can do nearly anything you want to do if you know what you are doing.

This power and flexibility are something new in personal computing. In the past, users took decision support to mean packages such as Stats from KnowWare. Stats lets you view and analyze figures and statistics related to your business. While it is a very useful package, and with it you can see trends in your business you might not catch otherwise, it is not in the same league as the other packages discussed here. It's not a DSS, and it makes no claims to be one, but for businesses that don't need or don't want to try a full-blown DSS, software like Stats makes an excellent bridge.

Your organization will get used to using personal computers in decision making and in analyzing business operations. Then, once the time comes when a move to a full DSS makes sense, your organization will be used to the concept, and the infrastructure will be in place to take advantage of the power of a DSS.

Growth Area?

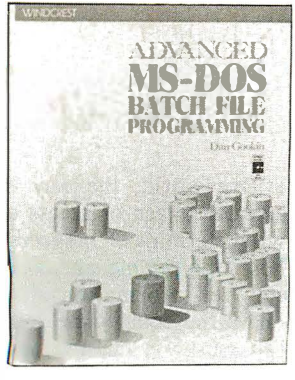
DSSes will be one of the business areas in which microcomputer applications will grow in importance as the millennium draws to a close. Now that personal computers finally have enough power to support and run actual mainframe applications, those applications will begin to migrate to the desktop. The reason for this, as I mentioned earlier, is cost.

As businesses find themselves in a

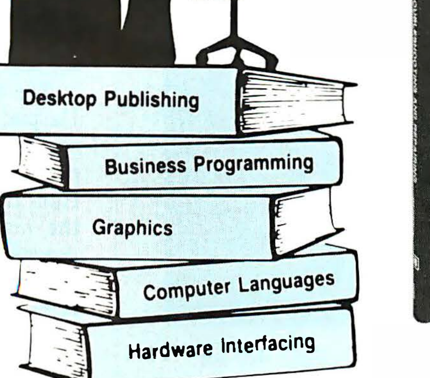
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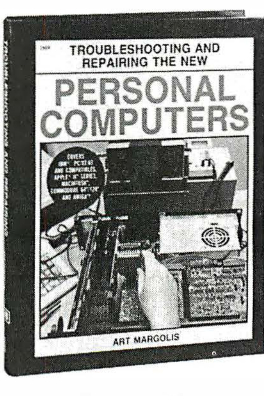
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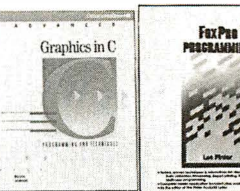
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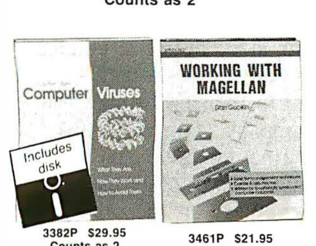




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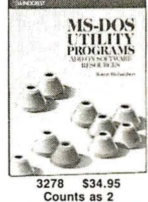
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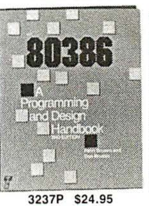
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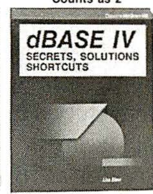
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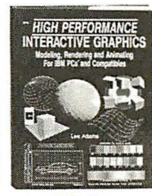
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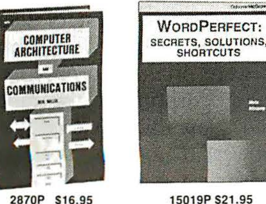


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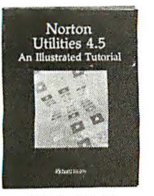


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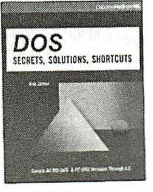


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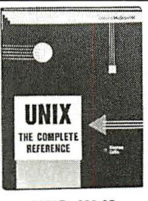
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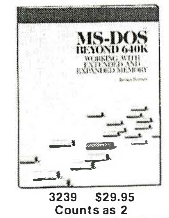
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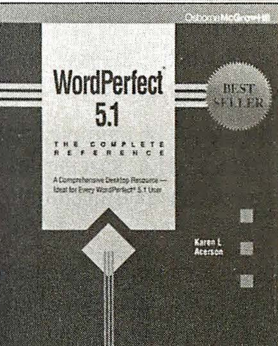
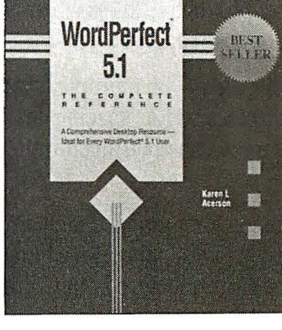
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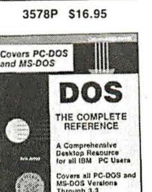
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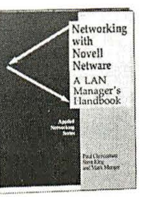
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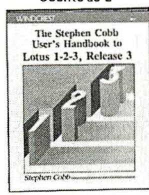
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3440P $17.95



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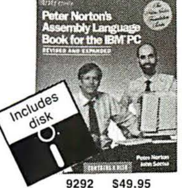
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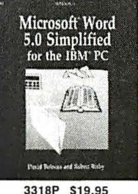
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WordStar 5.5 in a Day — 3330P $19.95 Counts as 2



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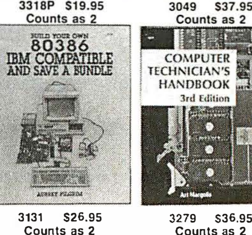


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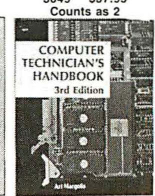
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more competitive world, the way in which they take advantage of access to information will determine their success or failure. Those who can manage, analyze, and interpret information on a desktop will have the competitive lead over those who must use mainframes, because they will have used fewer resources to accomplish the same end.

The role of microcomputers is clear. Despite their size, personal computers can offer the individual user more computer resources than he or she can get from the company mainframe, because the mainframe must be shared with dozens or hundreds of other users. Your personal computer, on the other hand, offers performance comparable to some minicomputers, and it is yours alone to use. For this reason, applications (such as DSSes) that once were considered to be useful only in the province of the corporate mainframe environment are now moving to the individual, giving the individual the power once reserved for the corporation.

DSSes are one of the first of these mainframe systems to make the move, because they were often used only by a few users in any corporation regardless of the platform. Now that personal computers are powerful enough, it makes more sense to give the user a powerful microcomputer and save the money spent on using the mainframe.

To date, most of the DSSes have been limited in scope. They have been packages like Stats, which, although useful, lacks the scope and power of a true DSS. Power has a price, of course, and the price is the level of performance required to support these systems. On the other hand, performance requirements will be one factor that will drive the next generation of hardware. SPSS and Business Wits are still packages that have functions that once required a mainframe, and to replace the mainframe, the microcomputer must have similar power. The 1990s will see the power arrive, and the power of the user will grow with it. ■

Wayne Rash Jr. is a contributing editor for BYTE and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

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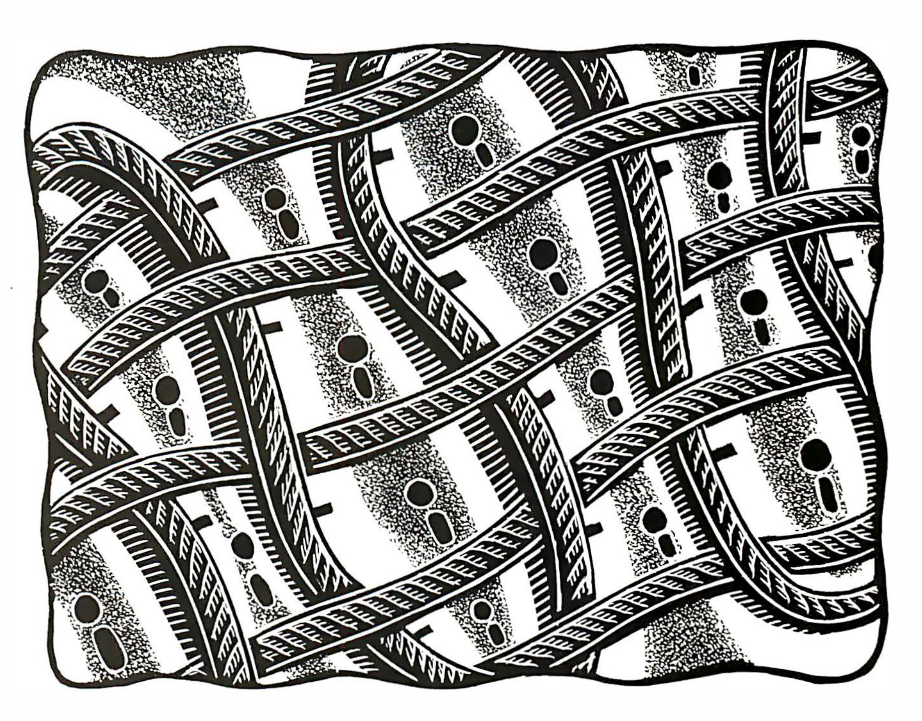
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MASTERING OS/2 THREADS

OS/2's unique style of lightweight multitasking taxes developers and rewards users



Don't make me wait! When I select Print, insert a new value into a spreadsheet, or resize a desktop publishing window, I don't want to be ignored while the application grinds away. None of us likes to wait, and applications designers have heard that message.

So spreadsheets today come with background recalc features, for example. But these features have taken forever to arrive, and they still aren't universally provided. If everyone knows what the problem is, why don't they just go ahead and fix it?

The answer is that background anything under DOS or Windows has to be custom-made. OS/2 is the first and only widely distributed system to provide a specific mechanism for dealing with problems of this class without building everything from scratch. OS/2 lets a designer cleave off compute- or I/O-bound activities as separately scheduled threads and thereby ensure crisp user interaction at all times.

Modes of Concurrency

When I talk about threads, I'm talking about concurrency: doing more than one thing at a time. The whole idea is to avoid having a processor sit idle when it could be doing something useful, and to be sure that what it is doing is most important.

Key factors that determine the performance of a concurrency mechanism are the time required to create and switch between tasks and the ease with which tasks can share information. Because threads carry less state information than normal OS/2 or Unix processes, the system can create and switch among them quickly. Because they share memory, tasks enjoy high-bandwidth communication.

The idea isn't completely new. Researchers in the Unix community, particularly at the Carnegie Mellon University Mach project, have talked about lightweight processes for several years. But OS/2 is the first commonly available system to implement this strategy.

A thread is a simple flow of control within a process. Its state consists of an instruction pointer, a stack, a register set, its priority, and certain types of semaphores. Everything else—memory (i.e., instructions and data), file descriptors, even the current disk and directory—is shared with the other threads in the process. Threads, like interrupt routines, require the designer to identify critical sections and implement resource-sharing protocols.

Threads run inside processes, which in turn run inside screens. The progression from threads outward to screens entails more and more "fire-walling" on the part of OS/2.

But the most important distinction is that while processes and screens are normally used for sharing the processor between applications, threads are uniquely a way of sharing the processor inside an application. That means more responsive single-user applications and, just as important, high-performance server applications. Distributed databases that manage transactions using threads, rather than entire processes, can be highly efficient.

Where Are the Applications?

So now I'm back to almost the same question: If everyone knows what the problem is, and if OS/2 provides the means of solving it, why don't you see

continued

many great multithreaded OS/2 applications?

To start, building a multithreaded application takes a tremendous amount of hard work. Elaborate handshaking is required to ensure that threads don't trample over each other. Everything has to be reentrant, compiled with the right options, and linked with the right libraries. Any shared resources have to be semaphored, and all that semaphoring has to be carefully constructed to avoid race conditions anywhere that could result in "deadly embrace." If the term deadly embrace is a bit fuzzy, trust me, writing your first multithreaded application will give you a good visceral feel for it.

Whenever a thread needs to "own" something, you have to invent a mechanism for the purpose. For example, when building the Hamilton C shell, a highly multithreaded command processor for OS/2, I had to come up with a way for a thread to maintain the notion of a current directory. It would hardly have been acceptable if a script running quietly in the background could suddenly, without warning, change the foreground current directory. Building a high-performance mechanism to re-create a current directory notion for each thread turned out to be a challenging project.

Debugging can be a real treat. Since the kernel's decisions about what thread gets to run next depend on what segments are loaded, setting a breakpoint can (by forcing a segment to be loaded) cause a different execution order. Here's the software analog of the hardware bug that disappears when you put the scope probe on it.

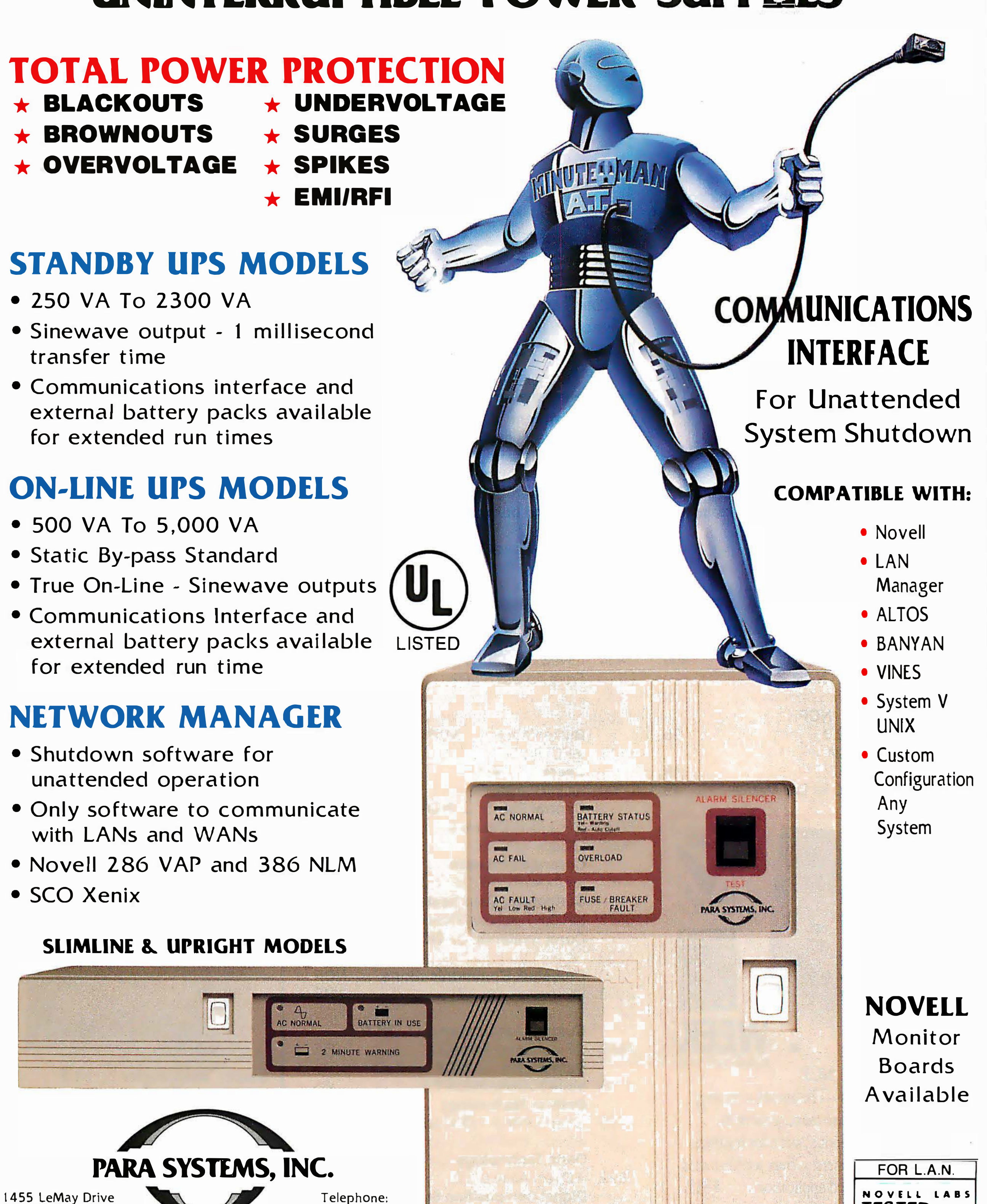
Not for the Faint of Heart

When I began working on the C shell in the summer of 1987, I worried a lot about possible competitors doing the same thing (i.e., building Unix-style tools for OS/2). It seemed like an obvious need, and I knew others were equally capable of writing such things. But mostly, that didn't happen. I wondered why.

One thing that I suspect is that most people who did try to build OS/2 applications came from the DOS world. Swamped by the sea change to multitasking and multithreading, they had difficulty making headway. Time invested with DOS, unless it was spent working on device drivers (which raise acute issues of concurrency), isn't good training for OS/2 threads.

Documentation didn't help. I remember opening my first OS/2 Software Development Kit (SDK) and reading that "a

continued on page 110



Circle 218 on Reader Service Card

No more foam peanuts

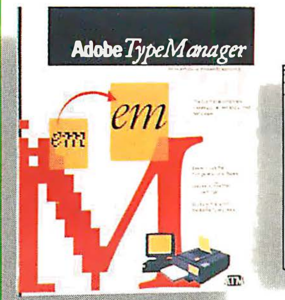
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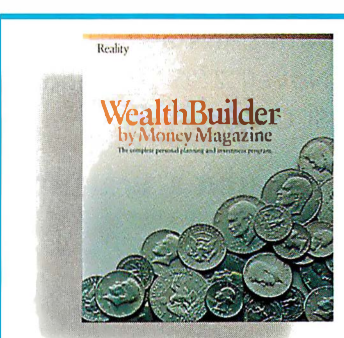
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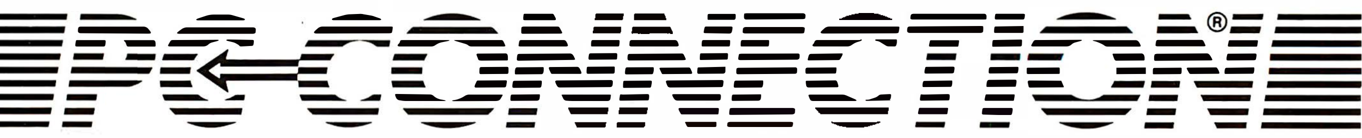
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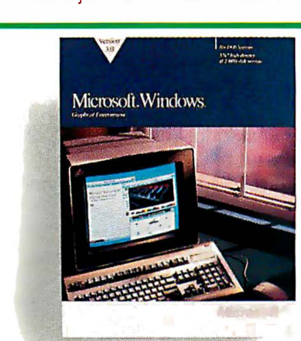


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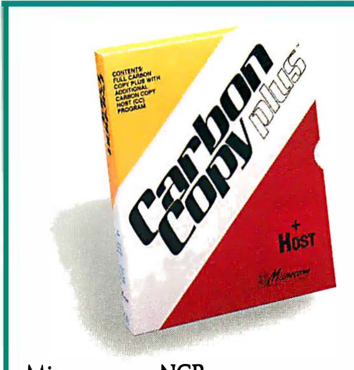
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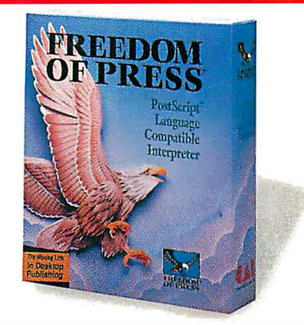
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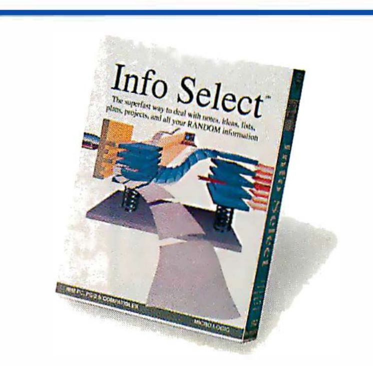
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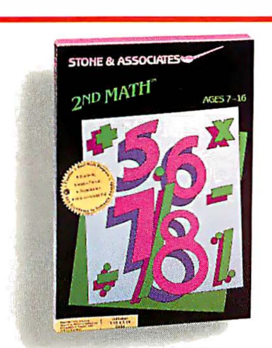
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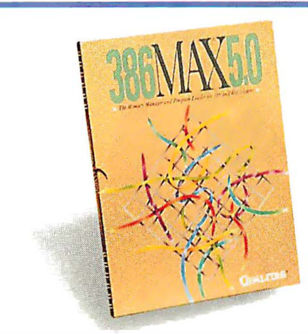


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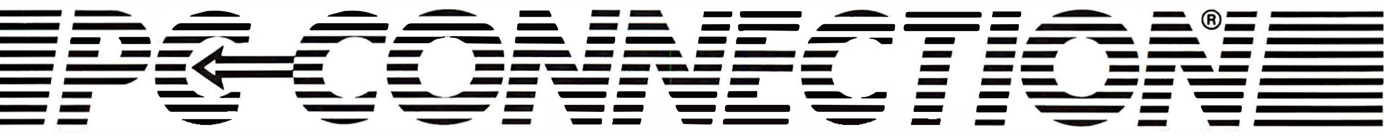
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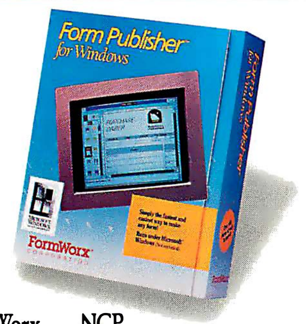
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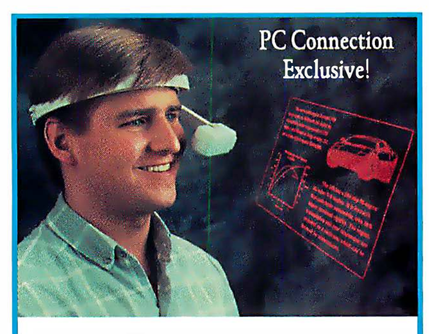
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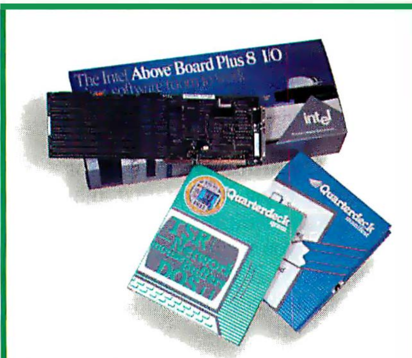
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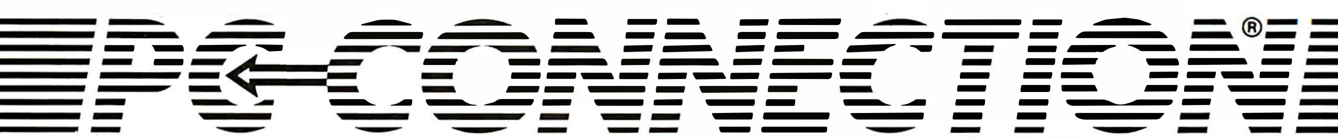


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thread is a dispatchable element used by MS OS/2 to track execution cycles of the processor." Three years later, that still doesn't tell me anything.

Then came the infamous MTDYNA .DOC. At first, you couldn't use the C library if you wanted to use threads, because the library routines weren't reentrant. In the spring of 1988, a new release of the C compiler brought the multithreaded library and headers and a 1039-line read-me file, MTDYNA.DOC, buried on one of the disks. For two years, that was the only official documentation for most of us.

Other roadblocks have been the constantly changing "musical header files." I know I've not been alone in just dreading each new SDK or Toolkit release. Each one seemed to bring a new set of seemingly gratuitous changes to all the names defined in the headers. First it was all uppercase, then mixed case; first English, then Hungarian. Each release meant nothing would compile until I'd made all the same gratuitous changes to all my own source code.

Least Common Denominator

The other big reason that there aren't many great multithreaded applications is that once you write one, it's not portable. Conversely, if you're porting something in from another environment, you don't just add threads and stir. To really use threads, you have to weave them pretty tightly into the fabric of your product. And let's face it: It's one thing to be nonportable if you're selling to an installed base of 50 million users, and quite another to a base of only 300,000.

Not surprisingly, most of the first wave of applications for OS/2 have been ports from DOS or Windows. Microsoft's own Word 5.0 and Excel are two very disappointing but typical examples of programs that do absolutely nothing to take advantage of OS/2. Neither Word nor Excel will do background printing; Excel doesn't even let you move its window around while it prints.

The arrival of Windows 3.0 clouds things further. With the upcoming capability of OS/2 2.0 to run Windows binaries unmodified, many developers may think that the right answer is the purely opportunistic one: Write it for Windows, and if it works on OS/2, fine, but don't do anything special. In other words, don't use threads.

What's the Prognosis?

In my view, the prognosis is mixed. On the technical side, things have improved. Documentation is much better. Many books show how to write a multithreaded program. From discussions I see on BIX and elsewhere, most developers seem to be gaining the familiarity and experience they need.

OS/2 2.0 promises a new, improved semaphore application programming interface that's touted as easier to use, although I'm skeptical. In my experience, it's not the semaphore primitives that are at fault, it's that semaphores are inherently tricky. Race conditions are just plain tough to avoid and even tougher to debug.

I see nothing that changes that. Some version 2.0 changes appear to be more musical headers. For example, the so-called FS (fast, safe) semaphores introduced with great fanfare last year are gone. What possible reason could there have been to introduce these semaphores at all if they were going to be eliminated so quickly?

But the biggest impediments to seeing all those great multithreaded applications now and through the rest of the year will be nontechnical. If sales of OS/2 continue at current levels, don't expect much.

Still, there's hope. Although Windows 3.0 will likely give all of us in the OS/2 community gas pains, it may ultimately be the best thing that could happen to OS/2. If you have the hardware to run Windows 3.0 acceptably, OS/2 should run fine also. OS/2 2.0 will make the migration easier. I have one DOS box right now, and, for me, it's one too many, considering how often I bother with it. But I admit even I was strangely captivated to see multiple DOS applications like good old Lotus 1-2-3 running in Presentation Manager windows under OS/2 2.0.

Ultimately, competitive pressures will grow as more users and developers learn just what can be done with threads. Unlike breakfast cereal, where you can eat the whole box and still have no idea whether it's any good for you, most folks figure out pretty quickly whether new software is any good for them. Take heart: OS/2 threads, used properly, are very good for you—enough so anyone can notice. ■

Douglas A. Hamilton is the founder of Hamilton Laboratories in Wayland, Massachusetts, and the author of the Hamilton C shell, a command processor and utilities package for OS/2. He can be reached on BIX as "hamilton."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.


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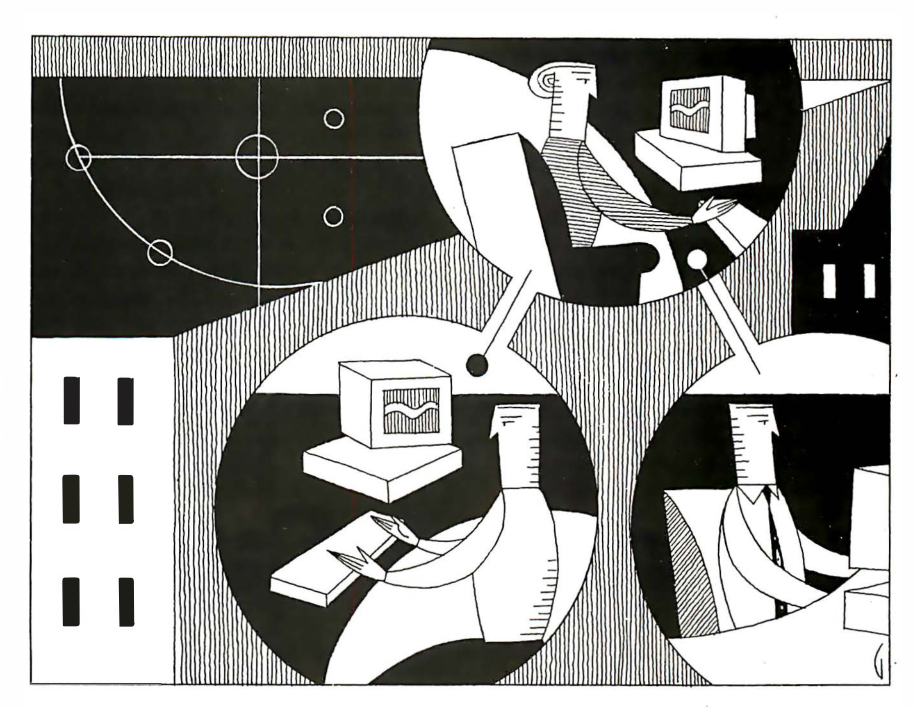
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UNITE OR DIE

For LANs to continue their explosive growth, networks must become essential parts of everyday life



Like mainframes and minicomputers before them, LANs are rapidly approaching a critical juncture at which they must either make a major leap forward or face diminishing sales. Mainframes and minicomputers never made that leap, but we hope that LANs will. To do so, they must evolve from a merely useful technology into an essential one.

Current LAN applications won't take LANs over this hurdle. The vast majority of today's LANs let their users share files and printers. Those functions are important, to be sure, but cheaper solutions—such as peripheral-sharing devices and sub-LANs—are available.

The future of LANs will involve a union of three of today's hottest application areas: groupware, database servers, and multimedia. Each of these areas holds a key component that the others lack. Alone, each will undoubtedly enjoy a great deal of success, but together, either united into stand-alone applications or as pieces in a cooperative system, they have the potential to help LANs take that next step forward. To see why, we'll briefly consider each area individually.

Groupware

Many industry observers have hailed groupware as the class of killer applications that will "make" LANs. Indeed, the idea of groupware—software that helps people work together better—is a good one. Most groupware products aim first at the central problem of any group interaction: communication.

Not surprisingly, E-mail is typically the cornerstone of most groupware packages. For example, the heart of Higgins, a package from Enable Software (Ballston Lake, NY) is a strong E-mail system. Higgins's other features, such as group scheduling, are closely linked to its E-mail.

With a basic communication mechanism in place, different groupware packages concentrate on other aspects of group interactions. For Syzygy from Information Research (Charlottesville, VA), the focus is project scheduling. Syzygy uses a central database of projects and resources to let users coordinate work on potentially large endeavors. Notes from Lotus Development (Cambridge, MA) concentrates on managing shared documents. And so on.

All those goals are worthy ones, but they are neither particularly new nor enough to maintain the phenomenal growth rate that LAN sales have enjoyed to date. Many of the same features have been available for years in such minicomputer "office automation" (read "groupware") packages as Digital Equipment's All-In-1 and Data General's CEO Mail (CEO stands for Comprehensive Electronic Office). The minicomputer packages definitely helped minicomputer sales and even landed many new sales, but the march of technology is still, for the most part, leaving minicomputers behind.

Database Servers

Like groupware, database servers, the usual center of the oft-touted "client/server" architecture, have played the role of LAN savior for some time. They hold the promise of many LAN users not just sharing files, but also running transactions against the same data sets. Before long, these LAN database servers will

continued

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ship in large quantities.

The primary feature of these LAN database servers will be one that has long been available on minicomputers: concurrency control, the good management of multiple users of a single database. Instead of the file-locking or manual record-locking of most current LAN applications, these servers will provide integrated transaction-management systems that correctly handle multiple simultaneous users. Solid, record-level concurrency controls are a crucial aspect of sharing data, and they are generally lacking in LAN applications.

LAN database servers also will bring to LANs a feature that is not available from minicomputers: the ability to move a large part of the application processing—the client portion—off the server system and onto the client systems. This step, however, is not as new as it might seem. Most minicomputer database systems already run as their own processes, with applications as separate processes. The client/server architecture involves little more than moving the application process from the server machine to the client machine and making sure that the two processes can communicate efficiently—not a trivial task, but certainly not one that represents a major step forward.

Products in the areas of groupware, database servers, and multimedia must work together in cohesive packages.

Regardless of their technical virtues, database servers alone won't save LANs. Like office automation packages, database systems prolonged the life of minicomputers and mainframes and in some cases even gave those large systems new jobs as powerful central servers, but they were not enough to maintain the high sales growth that those systems once enjoyed.

Multimedia

People don't communicate solely with the written (or typed) word. Sound and visual information are a key part of the interactions in any office. No matter how automated an office gets, people will still hold meetings, want to see each other's faces, and just talk. A picture will still be worth a thousand words.

The current push toward multimedia on many different fronts is the computer market's recognition of this fact. Most of the push is coming in two areas. The one that gets the most ink these days is the multimedia presentation, in which often-dazzling, MTV-like demonstrations combine traditional computer displays, animation, video, and digital audio. The other, only slightly quieter area is the rewiring of America with fiber-optic cable and other high-bandwidth technologies. Fiber-optic cable's high capacity gives it the potential to bring computer data, telephone calls, TV, and streams of other data surging into our homes and

continued

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Both of these areas—particularly the high-bandwidth technologies—have the potential to help LANs, but they are still young. We're only just beginning to deal well with sharing text documents on LANs; sharing multimedia presentations is necessarily a step or two behind. Fiber-optic cable has the potential to be great, but it's still relatively expensive, and we're just learning how to use it well.

All Together Now

If LANs are to make the crucial transition from useful to essential, products in the areas of groupware, database servers, and multimedia must learn to work together in cohesive packages. Each offers an answer to some of the crucial weaknesses of the others. Consider the following cases in point:

- Groupware provides textual communication (e.g., E-mail) and the ability to share selected information (e.g., projects and documents), but the database core is rarely strong enough to let many users work simultaneously without compromising the integrity of the shared data.
- Database servers handle the above problems, but they don't yet deal well with crucial information like text and graphics.
- The database systems now commercially available also don't do a good job with truly distributed databases, where single logical databases are spread across multiple servers—a must in almost any organization with multiple sites. Concurrency problems are hard enough on a single-system database, but they become extremely difficult when the data is on multiple machines. The theoretical answers to these problems have been around for years, but vendors are just now beginning to ship systems with two-phase transaction commits and the other necessities of distributed databases.
- Groupware and E-mail products are also facing their version of this distributed data problem, because it is increasingly important for users on different servers in a local- or wide-area network to be able to exchange messages. Many of these products now can work with multiple servers, but, as on a single server, they generally do so without a strong database core.
- Multimedia packages let people merge voice, video, and computer-generated graphics with more traditional data, but they are generally not integrated with databases or with underlying communication (e.g., E-mail) technologies.
- The high bandwidth of fiber-optic cable offers the potential for LANs to move the large amounts of data that these complex unions necessarily involve, but first we must figure out how to store and manage such integrated messages.

A system that unites all these elements, a network in which your personal computer is your gateway onto a network of shared information of all kinds—from today's record- and file-oriented data to voice and video—now that's a system that you'll rapidly find essential.

We don't expect such a system to come from a single vendor. We don't even want it to come from one vendor. Instead, such a system will probably be a set of cooperating products from several different vendors.

For that to happen, these different technologies must be able to work together cleanly. Standard interfaces, such as the E-mail MHS (Message Handling System) and X.400 protocols that let different packages exchange messages, are an important part of the answer. They let vendors of different components concentrate on their particular slices of the pie, knowing that, as long their products use the standard interfaces, they will be able to work with the important products in the other areas.

Equally important are new capabilities that each of these products must offer the others. Databases, for example, must provide tools for storing and managing text and graphics better. Groupware and multimedia packages must, in turn, yield their data management problems to the more capable hands of the database systems. You get the picture.

If such systems actually appear, being tied to a network will be as natural as holding a meeting or making a call—and as crucial to successful business. Personal computers, and the networks that link them, will become information appliances much like telephones and phone networks, and they'll be just as essential. With such systems, the question about LANs will not be who needs them, but rather, who can afford not to have one. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

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Take our **Master Switch**™, a sophisticated sharing device, combine it with **MasterNet**™ networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

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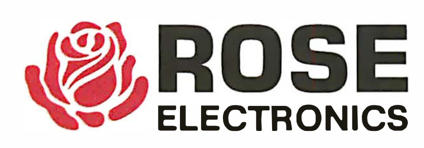
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Circle 255 on Reader Service Card



Cure For The Common Clone

IMAGINE. 386sx power, 200 MB-HD, 8 MB RAM, 1024 x 768 VGA with an internal modem...and it fits in a briefcase!

Introducing the Brick.™ A 386sx with enough power, storage and graphics capability to run the most demanding applications. And it's the first desktop PC that's quiet enough, small enough and elegant enough not to be banished instantly to the floor. This remarkable computer measures 3"x 8"x 11" and weighs only 8.3 lbs.

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The Brick offers an alternative to the usual trade-offs associated with laptops. Simply keep a full sized monitor and keyboard at your home and office, and carry just the Brick in between. You save half the cost, half the weight, and all the hassle of coordinating files between multiple machines. *You can have **one** machine with all your files wherever you need it.*

A Powerful And Quiet Desktop

Bricks are available with a 16 or 20 MHz 386sx; a 387sx coprocessor; 1 to 8 MB RAM; and your choice of a 40 (25ms), 100 (25ms), or 200 MB (16ms) hard disk. Bricks also deliver superb VGA graphics with 1MB video RAM supporting 800 x 600 and 1024 x 768 resolution for CAD, DTP or Windows. As an added benefit, the Brick is very quiet. Its rugged aluminum case serves as a heat sink so the whisper fan rarely runs.

832k for DOS

The Brick provides another welcome bonus: an extra 192k of memory above the DOS 640k limit. This unique feature allows you to load resident programs, such as a network or TSRs, into a contiguous 192k block of



The Brick fits in half a briefcase, leaving room for everything else you have to carry.

Circle 111 on Reader Service Card (RESELLERS: 112)

The Brick
3"x 8"x 11"
Only 8.3 lbs.

high memory, and still leave the lower 640k free. The regular Brick shown above also accepts an internal ISA 16-bit half length card, while the "Stretch Brick," shown at right, accepts one full and one half length card.

Great Value

Complete Brick systems start at just $2,495. For your convenience, we also offer pre-installed software packages – including the DESQview™ or the new Windows® 3.0 environments – and top-rated applications. For example, the system (shown above) including all standard Brick features with optional color VGA monitor; 4 MB RAM; and a 100 MB hard disk pre-programmed with DESQview 386, Quattro®, Sprint®, askSam™, DOS™ and Tree86™ is only $3,995! With this package, we also include our exclusive interactive "Talking Tutorial" that quickly teaches you how to use each program. *Yes, the Brick actually talks.*



Optional paper white VGA LCD display with back-lit super twist technology.

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You'll find complete information on all Brick systems, plus a full complement of enhancements including FAX and networking cards, tape backup unit, cases, monitors and more in our 32-page catalog. Why not call for it today?

Ergo also offers a line of traditional 386 computers, from 16 to 33 MHz, starting at just $1,895. Call us at **1-800-633-1925** and we'll help you select the system that best meets *your* needs.

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$2,495

System Includes

- ▲ Stretch Brick
- ▲ 16 MHz Intel 386sx
- ▲ 1 MB RAM, Exp. to 8 MB
- ▲ 40 MB hard disk with password protection
- ▲ Mono VGA monitor
- ▲ 16-bit full and 8-bit half card expansion slots

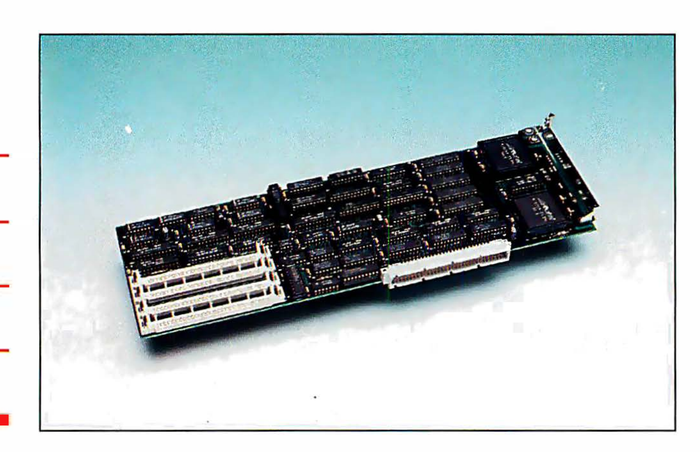
Standard Features

- ▲ 1024 x 768 VGA controller with 1MB video RAM and EGA, CGA, MDA support
- ▲ 101 keyboard
- ▲ 2,400 bps modem
- ▲ 3.5" 1.44 MB floppy
- ▲ 2 serial & 1 parallel port
- ▲ World wide AC power
- ▲ Hypertext manual
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- ▲ LIM 4.0 EMS support
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- ▲ Freight included

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RasterOps Accelerator Speeds Mac Graphics

A Mac II combined with a 24-bit color video board produces dazzling graphics. It makes the Mac a useful tool for professional art, graphic design, image manipulation, and color desktop publishing. However, working with near-photo-quality images or fancy graphics is *slow*. That's because you're working with 32-bit pixels (only 24 of the bits actually contain color data, hence the term 24-bit color). This means the Mac must muscle around about a megabyte or more of data when the screen is redrawn.

A faster Mac does little to help the situation: Even a 24-bit color screen redraw on a Mac IIfx using a 640- by 480-pixel display is a trifle poky. The solution is to off-load some of the QuickDraw graphics operations performed by the Mac's CPU onto a dedicated graphics coprocessor. Several vendors—Radius, SuperMac, and even Apple—have introduced graphics boards that accomplish this.

Now there's the **RasterOps Accelerator**, which off-loads and boosts the speed of certain QuickDraw operations like fills and window movement. Like Radius, RasterOps uses a separate NuBus board that contains the accelerator logic. The Accelerator can't generate video signals itself: It boosts screen performance by minimizing CPU-to-NuBus traffic and directly manipulating the frame buffer of a separate NuBus video board.

An `Accelerator` cdev/INIT patches QuickDraw so that certain drawing operations become coprocessor commands. It is these commands, not the usual pixel data, that the CPU writes out onto the NuBus. This reduces the amount of data that passes through the slow NuBus interface logic. These commands are executed by the Accelerator, which then modifies the frame buffer's contents at NuBus transfer rates. The Accelerator supports both NuBus block transfers (a special mode where up to 64 data bytes are rapidly sent across the bus) and bus locking (the Accelerator owns the bus continuously over numerous transfers). This last feature provides a claimed 25 percent to 50 percent boost for accelerated graphics operations.

Finally, like the Radius and Apple graphics boards, the Accelerator operates as a NuBus bus master. This lets it control and accelerate not only its Imager 8L and Imager 24L video boards, but other NuBus video boards that support block transfer operations (e.g., Apple's 8•24 card and Radius's DirectColor/24). The Accelerator's bus-locking feature also boosts the speed of video boards that support this capability, such as RasterOps video boards and Apple's Mac II 8-bit board.

The Accelerator provides four single in-line memory module sockets, where you can mount four 1- or 4-megabit-density, 80-nanosecond SIMMs to create a RAM buffer that is 4 or 16 MB in size. The Accelerator intercepts special graphics functions (called `GWorld`) and routes the off-screen image data they work with into this buffer. This lets the Accelerator operate on the image in its local buffer, rather than wait for the Mac's CPU to write it to the frame buffer. `GWorld` functions are new; not many Mac applications take advantage of them, so the buffer can serve as a RAM disk. You don't need this RAM for the board to operate.

I tried the Accelerator with its version 1.0 software, a RasterOps Imager 24L 24-bit color video board on a Mac IIci and a Mac IIfx running System 6.0.5. Both machines were equipped with 4 MB of RAM and an 80-MB hard disk drive. The Mac IIci drove a 1024- by 768-pixel monitor, while the Mac IIfx drove a 640- by 480-pixel monitor.

Screen updates and desktop drawing were noticeably faster with the Accelerator. I used PageMaker 4.0 to create a 6-MB test file populated with two 24-bit PICT images, two 24-bit TIFF images, and several typefaces. I then scrolled about the document's pages and recorded the times. Depending on the position and type of image on the pages, scrolling rates improved by from only a few percent to nearly 50 percent. I also tried Apple's 8•24 board with the Accelerator and observed a perfor-mance improvement of about 11 percent peak—not as fast as RasterOps' own board, but an improvement. I also installed 4 MB of RAM on the Accelerator, and when I rebooted, a RAM disk of that size appeared on the desktop. Both the Accelerator and the Imager 24L worked reliably. The fact that the Accelerator works with other vendors' boards and multiple boards is a plus. If you plan on doing lots of 24-bit color work on your Mac, you might want to check out the Accelerator.

—Tom Thompson

THE FACTS

RasterOps Accelerator
without RAM, $495; 4-MB RAM expansion kit, $795

Requirements:
Mac II running System 6.0.3 or higher with 32-Bit QuickDraw and 2 MB of RAM.

RasterOps
2500 Walsh Ave.
Santa Clara, CA 95051
(408) 562-4200
Inquiry 999.

Stuff Your Data into a Backpack

You wouldn't take MicroSolutions Computer Products' **Backpack** on a hike, but it does hook up to the back of most computers, and it adds an extra external floppy disk drive (either 3½- or 5¼-inch) to your system with an absolute minimum of fuss and bother.

Backpack's biggest selling point is that it doesn't need an expansion slot or special gadgets to get connected; it simply plugs into a parallel port. And that doesn't mean that you lose a printer port, because Backpack has a jack on its own panel where you plug in your printer. The drive and the printer cooperate and manage to share the port without getting in each other's way.

To install the Backpack, I plugged it into my computer's parallel port, hooked up its power supply, and switched it on. Then the installation software installed the device driver that Backpack needs and copied a special formatting program to my hard disk. It was then a simple matter to reboot the system and get to work. Backpack became the next drive (E) on my system. No muss, no fuss.

The Backpack that I tested was the newest version, handling the new 2.8-megabyte *extended-density* disks that will undoubtedly soon become a standard. Backpack formatted an ED disk in just a bit more time than a 1.44-MB floppy disk, showing a formatted capacity of a healthy and handy 2,931,712 bytes. Backpack also handles 720K-byte and 1.44-MB floppy disks flawlessly.

Backpack expects a fully IBM-compatible parallel port, and some ports on low-cost clones aren't. They may work fine with a printer, but Backpack gets terminal indigestion. You should try before you buy.

Of course, at about $10 a crack, the special ED disks are expensive. You have to decide if you really need the storage space (and want to spend the extra $75 the ED drive costs). If not, there are MicroSolutions' lower-capacity (and lower-cost) alternatives.

The drives aren't cheap, but if you need to add a drive to a computer that doesn't have room for one, or want to add some utility to your laptop, Backpack fills the bill.

—Stan Miastkowski



THE FACTS

Backpack
5¼-inch (360K-byte or 1.2-MB), $425; 3½-inch (720K-byte or 1.44-MB), $349

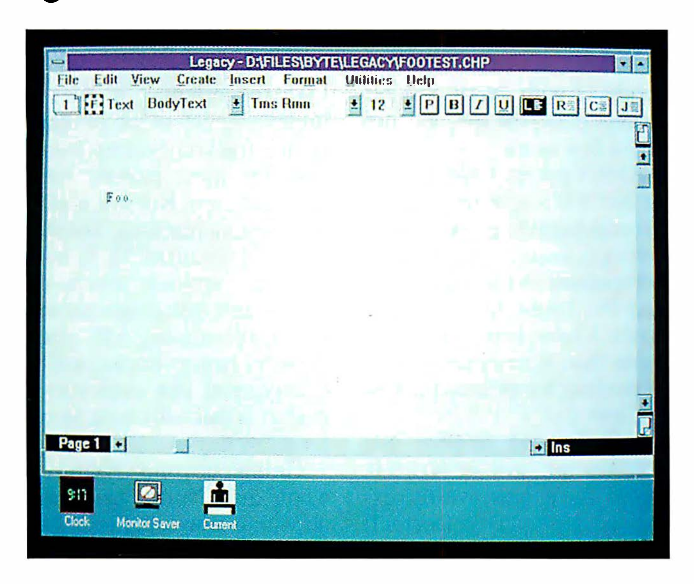
Requirements:
IBM PC, PS/2, or compatible with a parallel port.

MicroSolutions Computer Products
132 West Lincoln Hwy.
DeKalb, IL 60115
(815) 756-3411
Inquiry 1000.

Legacy: Processing Words Under Windows 3.0

If a Macintosh is the computer for the rest of us, NBI's **Legacy** must be the word processor for those rich in free space on their hard disk.

Legacy is a flexible and powerful program in most ways, but it is a disk-space pig. How so? Well, a file containing four printable ASCII characters takes up 15,322 bytes of storage space when stored in Legacy (.CHP) format. By way of comparison, the same file in Amí Pro (.SAM) format takes up 4183 bytes on the disk; in Word for Windows (.DOC) format, 1754 bytes; in Microsoft Windows Write (.WRI) format, 640 bytes; and in raw ASCII, 6 bytes.



As the amount of text in the file grows, the disparity between it and the disk space used shrinks, of course. For example, this entire Short Take, before editing, required 3393 bytes of disk space as an ASCII file. In Legacy format, it took up 18,706 bytes, and in Word for Windows format, 5338 bytes. This means that if your writing runs to memos, single-page letters, and other short compositions, Legacy is probably not the program for you. However, if you're looking for a program that adds some desktop publishing capa-

continued

bility to a full-featured word processor, Legacy should be on your check-it-out list.

Legacy requires DOS 3.2 or higher and Microsoft Windows 3.0, so you may need to upgrade your software. It's a full WYSIWYG word processor and allows screen images of up to 200 percent of actual page size. I found its draft-mode screen to be rather cluttered: Draft mode, in addition to displaying the actual text, also displays all tokens as a guide to what the formatted page would look like.

All the expected word processing features (e.g., cut, copy, and paste; search and replace; style sheets; spelling checker; thesaurus; automatic footnote, list, and endnote generation; hyphenation; headers and footers; and mail merge) are there. Dynamic Data Exchange and file linking are supported.

It can import and export text files in 15 different formats and import and export graphics files in 13 different formats. Tabular data in Lotus 1-2-3 and Microsoft Excel format can be imported, also.

Formatting and page layout are very powerful. There's no limit to the number of text, graphics, or table frames that can be used on a page. (A frame is simply a virtual box that holds a specific type of data. By having unlimited frames, it is—at least in theory—possible to build such complicated documents as a newspaper's supermarket ad or an illustrated page for an electronics component supply catalog.) A built-in editor can create vector graphics using object-oriented methods, much as high-end design programs like Micrografx Designer and Corel Draw can do. Text can flow across pages and columns into linked frames. Type sizes range from 1 to 792 points, and in normal, boldface, italic, overstrike, underline, superscript, and subscript.

—George Bond

THE FACTS

Legacy
$495

Requirements:
A 286- or 386-based computer with at least 640K bytes of RAM (1 MB is recommended), a hard disk drive (20 MB minimum is recommended), DOS 3.2 or higher, Windows 3.0, a Windows-compatible display device, and a mouse.

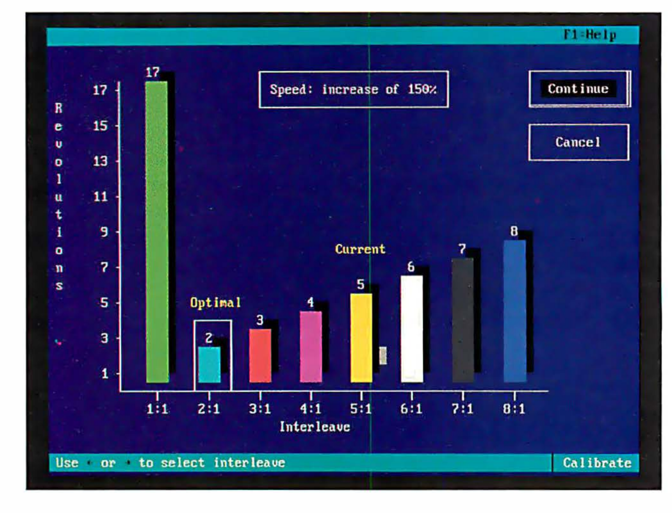
NBI, Inc.
3450 Mitchell Lane
Boulder, CO 80301
(800) 624-1111
(303) 444-5710
Inquiry 1001.

New Norton Utilities Puts on a Too-Happy Face

Norton Utilities 5.0 is loaded (or perhaps more accurately, weighed down) with a huge array of features that can be lifesavers for files, hard disk drives, and even whole systems. They're all tied together with a new Common User Access–like textual (pseudographic) interface that (for the first time) works with a mouse.

Ever since 1982, when Peter Norton released his seminal unerase utility and got the PC utility business off to a rousing start, the thing that I've liked best about Norton software is that it's always been lean, mean . . . and superb. Previous versions of NU were never chocked with features. They just did their job with a minimum of hassle. Sure, naive users could do real damage to a hard disk if they didn't know what they were doing, but that was part of the game.

In NU 5.0, Norton has unfortunately succumbed to the blatant featuritus that's recently affected the PC utility business. It's a cruel and competitive world out there, and today's conventional wisdom says you have to stuff your products with every possible feature under the sun, and then add a few more.



Don't get me wrong. Some of NU 5.0's new features are ground-breaking, as Norton attempts to stay ahead of arch-competitors like Mace Utilities and PC Tools. In the limited space I have here, I can't do more than scratch the surface of the long list of what the new NU can do.

All the old familiar NU abilities are still in NU 5.0. Some have been vastly expanded. Norton Disk Doctor II is the most obvious example. Like the original, it does a highly competent job of diagnosing (and recovering from) even the most esoteric hard disk problems. But in a nod to competitors like Disk Technician and SpinRite II, it now includes various levels of schedulable disk diagnosis and interleave tuning. If your drive's being occasionally cranky, you can even run a diagnosis that will chunk along for a few days.

Going beyond fixing a whole disk, Norton has come up with a new File Fix utility that attempts to recover the contents of corrupted files. The first release of NU 5.0 works with Lotus 1-2-3 and dBASE files, and the Norton folks say that file fixers for other popular applications are in the works. No utility can recover all damaged data; there are just too many variables involved. But NU comes close indeed.

NU 5.0 is the first Norton Utility that works on a network, and new utilities like Disk Monitor and Diskreet are designed for connectivity. Disk Monitor (a TSR program) keeps a record of all

continued

THE FACTS

Norton Utilities 5.0
$179

Requirements:
IBM PC, AT, PS/2, or compatible; hard disk drive required to run advanced diagnostics.

Peter Norton Computing
100 Wilshire Blvd.,
Ninth Floor
Santa Monica, CA 90401
(213) 319-2000
Inquiry 1003.



Embedded systems designers have already used **CrossCode C** *in over 577 different applications.*

CrossCode C comes with four powerful tools to help you program your 68000-based ROMable applications

From C source to final object, each tool takes you one step closer to your finished ROMable design

CrossCode C is designed specifically to help you write ROMable code for all members of the Motorola 68000 family. Four powerful tools take you from C source to object code:

1. **COMPILER:** To get truly ROMable code, you have to start with a truly ROMable compiler. Here are three **CrossCode C** features that you won't find in any ordinary C compiler:

- Compiler output code is split into five independent memory sections that you can assign into ROM or RAM as you please.
- You can optimize the code for your application because *you* control the sizes of data types. For example, you can optimize for speed by using two byte *ints*, or get maximum versatility by using four byte *ints*.
- You can easily write assembly language routines that call C functions and vice versa, because the compiler uses simple, well documented parameter passing conventions.

2. **ASSEMBLER: CrossCode C** comes with a Motorola-style assembler that has all the features that assembly language programmers require. In fact, you could write your whole application with it:

- The assembler features an advanced macro language, conditional assembly, "include" files, and an unlimited size symbol table.
- Detailed cross references show you where you've defined and referenced your symbols.
- After a link, you can actually convert your "relocatable" assembler listings into "absolute" listings that contain absolute addresses and fully linked object code.

3. **LINKER:** The **CrossCode C** linker is designed to handle truly huge loads. There are no limits on the number of symbols in your load or on the size of your output file. And you can always count on full 32 bit target addressability, because the linker operates comfortably in the highest ranges of the 68030's address space.

4. **DOWNLOADER: CrossCode C** comes with a *downloader* that puts you in touch with all EPROM programmers and emulators. It can convert your load into Motorola S-Records, Intel Hex, Tek Hex, Extended Tek Hex, and Data I/O ASCII Hex. You can also produce a binary image and convert that image into any format you might want. In all formats, bytes can be split into EPROMs for an 8, 16, or 32 bit data bus.

Why Wait

Once you start using **CrossCode C**, you may just wonder how you ever got the job done before! It's available under MS-DOS for just $1995, and it runs on all IBM PCs and compatibles (640K memory and hard disk are required). Also available under UNIX, XENIX, and VMS.

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SOFTWARE DEVELOPMENT SYSTEMS, INC.
DEPARTMENT 22
4248 BELLE AIRE LANE
DOWNERS GROVE, ILLINOIS 60515 USA

disk reads and writes, and of who does them. Diskreet (get the pun?) lets you store files in an encrypted form with password protection. Even better, the newest incarnation of File Find works across multiple drives (and across a network). Since I'm always tucking files away in some odd directory, File Find is the utility that I use most.

NU 5.0 keeps delivering surprises. A case in point is File Save, which essentially assigns priorities to files so that when you delete them (accidentally or on purpose), the areas they're stored on aren't immediately overwritten the way DOS normally does. It works like this: Say you've purposely erased an old version of a spreadsheet file and you realize several days later that you shouldn't have. Without File Save, chances are its area would already have been overwritten. But if you used File Save and gave the files high priority, there's a good chance you can still recover the original file by using NU 5.0's unerase utility.

Probably the biggest change in NU 5.0 is the System Information utility. In previous versions, it was a single screen of essential data about your system. In NU 5.0, it's been vastly expanded. The new SI gives you 20 screens full of data, from the essential to the esoteric. The whole thing's capped off by a little graphics show that presents your system's Norton SI rating on a graph and compares it to some other common hardware.

Topping off the list of new bells and whistles are Norton's first caching utility and a vastly improved disk sector editor (with split screen, cut and paste, and data links). Last, and certainly not least, Norton's unerase utility is faster and much easier to use.

The Norton folks say they've redesigned their utilities for today's "real business world," with many computer users who don't have lots of technical expertise. True. Norton Utilities 5.0 is chock full of text screens filled with explanations and helpful suggestions. But I can't help but feel that by stuffing in features and making it so user-friendly that it's almost bothersome, something's been lost for advanced users. There was something to be said for living dangerously.

—Stan Miastkowski

Hardware Directory Fits on Your Hard Disk

One of the nice things about this industry is that when you go to buy something, there are so many choices available. But that can easily be frustrating as well. How do you keep up with all the new products that become available? How do you decide among them?

A new software product for IBM systems that's called **HardFacts** attempts to solve this problem. This product includes approximately 6 megabytes of data on about 6000 hardware products. Almost every type of hardware product is included, from lightweight laptops to desktop i486-based systems, from keyboards to color monitors, and from scanners to tape backup systems.

HardFacts includes a large amount of information about each product. For most products, this entails about 50 pieces of information. Also, if the product has been reviewed in a magazine or has won any awards, that information is included. HardFacts mentions both the list price of the product and the street price, along with its distributors.

HardFacts was created using Nantucket's Clipper database manager and has a fairly straightforward user interface. When you are looking for a particular product, HardFacts lets you easily narrow the criteria for your search.

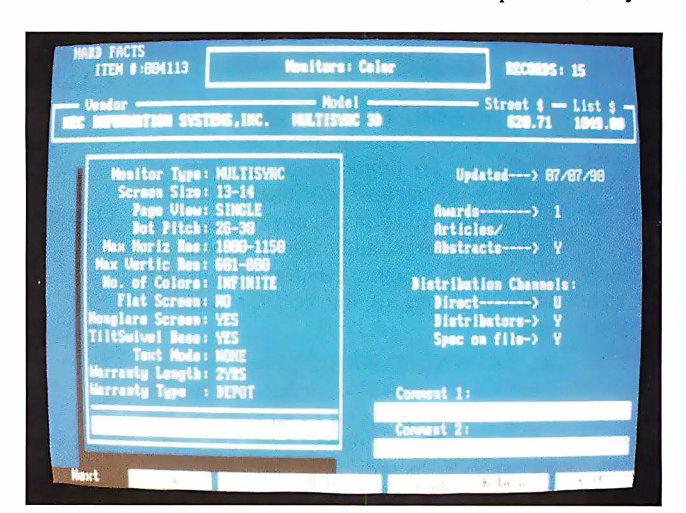
For example, HardFacts presents you with a large number of product categories. If you are interested in looking at tape backup systems, you simply select that category from the list. You can then choose to look at a list of all 140 tape backup systems, or you can narrow the search simply by selecting criteria from a criteria menu. You can, for example, select to see only those backup systems with capacities of less than 40 MB.

Of course, in any product like this, the value of the product depends on the quality and timeliness of the information presented. HardFacts solves the problem of timeliness by providing monthly updates for its database on a yearly subscription basis. As for the quality of the information, I will have to wait for a shipping version of the product before I give the final word. A prerelease version I worked with contained some good information. You can also judge the quality for yourself, since HardFacts has a 30-day money-back guarantee.

But no matter how good the database is, once you zero in on a particular product, you will usually want to see a brochure on it as well. And HardFacts has a good solution for this. For most products, all you need to do is call a special telephone number using the phone that's connected to your fax machine and feed in your subscription number and the code number of the product you are interested in, and the HardFacts folks will fax you the manufacturer's spec sheet.

HardFacts is a fairly expensive product and is not for everyone. But it is one of those products that can surely be used by everyone at one time or another. The question is whether you will need it often enough to justify the cost. For people who purchase or work with large amounts of hardware, HardFacts will be extremely hard to pass up. ■

—Rich Malloy



THE FACTS

HardFacts
$695

Requirements:
IBM PC or compatible with 640K bytes of memory and a hard disk drive with 6 MB of free space.

HardFacts
292 Cabot St.
Beverly, MA 01915
(508) 927-1370
Inquiry 1002.

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The OPEN LOOK™ user interface. It's a real hit with independent software vendors, in-house developers and end users. In fact, over 300 applications are in development today. By people like Lotus®, INFORMIX®, Island Graphics®, Interleaf®, and Frame®. And it's the most popular front end to UNIX®. For a number of reasons.

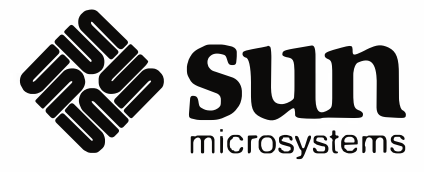
First of all, it makes UNIX easy to use. Because there are no complicated UNIX commands. It also looks better than any other interface. From its icons to its 3D elements. And makes users more efficient. For example, our drag and drop feature gives them a simple, intuitive way to move files around the desktop. Our push-pin icon makes it even easier to use. And OPEN LOOK gives users the same interface across multiple platforms, so they learn it once. And enjoy access to a huge range of network resources.

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Circle 280 on Reader Service Card

The NEC ProSpeed SX/20: Take It and Leave It

Speed and light weight separate this desktop/laptop from its SX competitors

Michael Nadeau

Expansion options that let laptops serve as both portable and desktop computers aren't new, but NEC Technologies' new ProSpeed SX/20 just might provide the best of both worlds in terms of totability and power. Running at 20 MHz and weighing just under 13 pounds with battery, the SX/20 not only outperforms its 16-MHz SX competitors, it's also lighter than almost all of them.

The optional Docking Station provides everything you need to transform the portable into a full-featured desktop unit. The machine's list price ($5999 for the SX/20, including keyboard and monitor; and $1199 more for the Docking Station) might seem steep, but $7198 is less than what you'd pay to buy top-brand desktop and portable PCs.

Speed and flexibility are just two of the SX/20's virtues. Standard features include a 2½-inch 40-megabyte PrairieTek hard disk drive; a 3½-inch 1.44-MB floppy disk drive; a detachable 83-key keyboard; a pull-out handle; serial, RJ-11, printer, and external monitor ports; 1 MB of RAM (expandable to 5 MB); and the best 640- by 480-pixel VGA LCD screen I've seen. MS-DOS 4.01, setup diagnostics, an EMS 4.0 driver, a disk-cache utility, and a RAM disk make up the standard software.

I tested a preproduction unit. NEC was still working on the BIOS (doing mostly performance tuning), but otherwise the system was essentially the same one that should be available in September.



Its crisp black-on-white VGA display is one of the NEC ProSpeed SX/20's most appealing features. Both text and graphics appear sharp and well-defined.

PRELIMINARY BYTE LOW-LEVEL BENCHMARK SCORES

The NEC ProSpeed SX/20's CPU performance is better than that of the Compaq 386/20 SX desktop system's. The Goupil Golf is a 16-MHz 386SX system also designed to work as both a portable and a desktop.

	CPU	Disk	Video
NEC ProSpeed SX/20	2.05	1.11	5.33
Compaq Deskpro 386s/20	1.76	2.91	8.21
Goupil Golf	2.18	1.86	4.33

Note: Benchmark results are indexed to show relative performance; higher numbers indicate better performance. For all indexes, an 8-MHz IBM PC AT running MS-DOS 3.30 = 1.

Traveling Light

Make no mistake; it's not easy lugging around 13 pounds of computer, even if it's just from your office to your home. NEC compensates for that fact by providing considerable processing power in a relatively small form factor. The BYTE low-level benchmarks indicate that the SX/20 is an able performer (see the table). And NEC promises speed gains once the BIOS is finalized.

At 13⅖ by 3⅘ by 10⅗ inches, the SX/20 fits snugly under your arm and is compact enough for you to carry by the handle without banging it on your legs as you walk. It will also fit into most briefcases, and NEC sells an optional carrying case. If you don't need the battery, you can simply pop it out and snap in the AC converter, thus saving yourself a pound of weight and the hassle of carrying the converter separately. By comparison, the recently introduced Compaq SLT 386s/20 is larger and more than a pound heavier.

The SX/20 will be among the first to use PrairieTek's 28-millisecond, 2½-inch 40-MB hard disk drives. This small form factor conserves space but limits disk storage options until higher-capacity 2½-inch hard disk drives become available. By contrast, Compaq offers up to 120 MB of hard disk storage on the SLT 386s/20. The optional Docking Station provides a 5¼-inch drive bay for additional mass storage.

Battery life is an adequate 2½ hours. The nickel-cadmium unit recharges in 2 hours using the AC converter with the machine off, or in 5 hours when the machine is in use. An optional battery charger can charge two batteries at a time. Other options include a 2400-bps modem ($399) and a 2400-bps modem with 9600-bps send/receive fax capability ($699). These modems install in a slot located under the keyboard tray.

The keyboard is intelligently designed and has a good feel, although the keys are not quite full-travel. The cursor-control keys are in the familiar inverted "T" configuration, and all 12 function keys reside on the top row. Fold-out legs on the detachable keyboard provide a sufficient typing angle.

For video, NEC uses a backlit LCD design that's a variation of film-twisted nematic technology. By removing one layer of glass on the screen and replacing it with a film layer, NEC claims to have reduced the weight of the screen by about 35 percent and improved contrast by roughly the same amount. A high-quality diffuser evenly distributes the fluorescent backlighting. The result is a crisp and easy-to-read black-on-white text display. When running Windows 3.0, however, I found myself frequently adjusting the brightness and contrast controls after switching from one graphical application to another.

A standby switch puts the CPU into low-power mode and shuts down everything else except memory; if you push it again, the machine comes back on to where you left it. A reset button, an unusual but welcome feature on a portable, is recessed into the side of the unit, out of harm's way. A password security feature is standard.

Meanwhile, Back at the Office

For power and features, the SX/20 lacks little, yet by itself it's not a suitable office system for most businesses. That's where the Docking Station comes in. This unit provides two AT-standard 16-bit expansion slots, two serial ports, one parallel port, two RJ-11 ports, external keyboard and video ports, and a drive bay. When docked, the SX/20 redirects blocked parallel, serial, and RJ-11 ports to the corresponding ports on the Docking Station. It also maintains two sets of AUTOEXEC.BAT and CONFIG.SYS files—one for the portable configuration and one for the desktop. NEC says this makes for a "one-touch transition" between portable and desktop configurations.

The SX/20 locks into the Docking Station by means of a 16-bit bus interface at the rear of the unit. Once the unit is attached, you can use the system on the desktop or as a floor-standing unit. With the Docking Station, you can expand memory up to 16 MB.

Who Is It For?

The NEC SX/20 is not for everyone. It's among the most powerful of the battery-operated portables, but it's also one of the more expensive. In the desktop configuration, you're limited to just two expansion slots and one drive bay. And $7198 will buy comparably equipped laptop and desktop systems from reputable vendors with lower list prices. (To be fair, NEC estimates that the price for a fully decked-out laptop/desktop version of the SX/20 could be as low as $5000 after discounts.) For those who depend on a laptop as much as their desktop and who require the horsepower to run compute-intensive applications, the SX/20 looks like a slick solution.

Combining desktop and portable systems into one unit is an important trend. More and more businesses are finding ways to use portable PCs to maximize the productivity of their personnel while they're away from the office. It makes sense to have one system that can serve double-duty—not just because it might be cheaper to equip people that way, but because it creates a better, seamless link between work done on the road and work done in the office. ■

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COMPANY INFORMATION

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Features
character outline
gray pattern filler

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The OKILASER 840 from OKIDATA provides high performance Adobe PostScript® with 35 scalable fonts resident. Capabilities are unlimited with the power to perform

Jan
Feb
March

Word Processors That Build Character

The BYTE Lab compares 15 WYSIWYG word processors for the Macintosh and the PC

Howard Eglowstein, Stan Wszola, and Tom Thompson

Word processing programs have been with us since the birth of microcomputers. Then, as now, they gave many people a tool to rapidly produce and modify large documents. The document's appearance was originally a secondary issue, partially because the printer technology at the time didn't give you much choice; you had to settle for the monospaced character font in the printer's ROM.

The situation has certainly improved since then. Today, you can select a particular typeface for your document and expect it to show up on the screen. It doesn't have to be a monospaced font, either. Even better, many laser printers will reproduce the document's typeface faithfully, at 300-dot-per-inch or better resolution.

Now that you have better control over the look of the output, you need a good idea of how the document will appear before you commit it to paper. Will adding that table of cost-justification figures to the business report bump the text explaining the costs to another page? Can you add a logo to the company's letterhead? How will it look?

Any word processing package gives you a tool to organize your thoughts and correct your grammar before you commit it to paper; WYSIWYG helps you make it look attractive.

Typing, or Typesetting?

Character-based word processing isn't dead—far from it. Modern word processors offer a lengthy list of formatting features, and they usually provide a substantial preview mode to let you check on the final output. When choosing a word processor, choose WYSIWYG when the look of what you write is almost as important as the content. Drawing a line between WYSIWYG and desktop publishing is somewhat harder; at some point, you'll finish composing your text and concentrate on the layout. Even the best of the WYSIWYG word processors fall far behind a DTP package for final formatting. If you find yourself spending lots of time adjusting fonts and moving graphics, maybe you should be using a DTP package instead.

Like DTP packages, WYSIWYG word processors allow you to integrate text and graphics onto the same page. Drawing tools, graphics file import functions, and graphical manipulation functions let you insert symbols, logos, and illustrations directly into your document. File import functions let you place high-resolution graphics, and usually the text will automatically flow around the image.

The products that we've looked at for this Product Focus cover the entire spectrum of word processors, from full-featured packages such as Amí Professional and Microsoft Word to rather specialized packages such as InText and MindWrite.

Seeing Is Believing

To test these products, we ran them on a variety of machines. We ran the DOS products on a 20-MHz Compaq 386 with a VGA monitor and 6 megabytes of memory. For the lower-end products, we wanted to see how they performed on a low-end machine. Another Compaq did the trick—a Compaq Plus portable, with the original 4.77-MHz 8088 and 640K bytes of memory. Although Windows 3.0 will run on the Plus's internal CGA, the 8088 is hardly the processor to use for serious Windows work. We didn't bother testing the Windows word processors on the Plus.

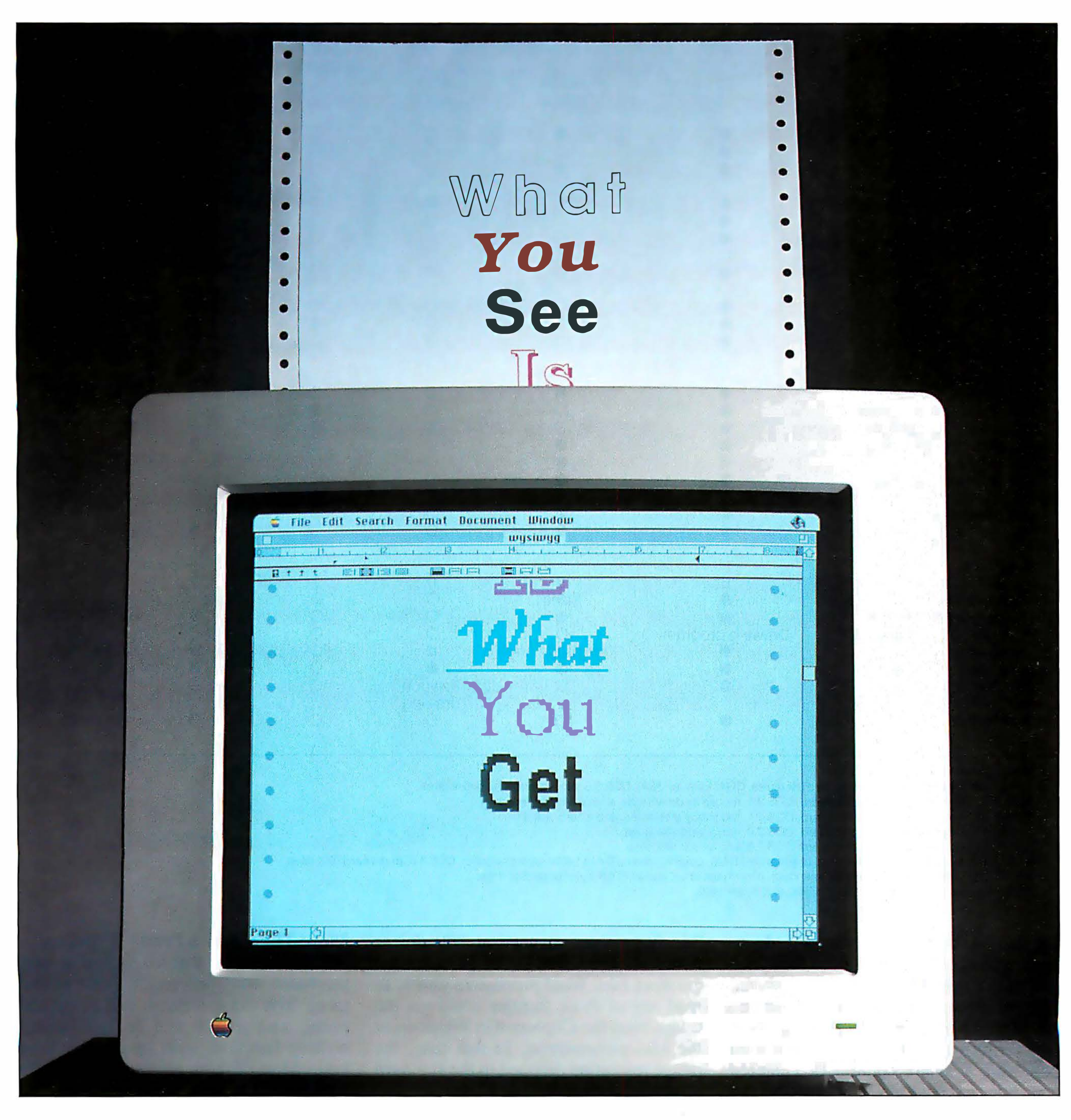
We ran all the Macintosh products on two systems: a Mac SE with 4 MB of memory, and an SE/30 with 2 MB. We found the general performance of all the word processors to be adequate on the SE. Of course, the Mac SE/30's 16-MHz 68030 had more than enough horsepower to keep up with even the fastest typist. All the test machines had hard disk drives with at least 8 MB of free space. Our PC compatibles used an HP LaserJet III with a PostScript cartridge for output, and the Macs used a networked LaserWriter IINT.

To get a feel for overall performance, we asked each of the word processors to perform general functions that typify the way you'd use a word processor. The ASCII text-import and save-to-disk tests provide information on general disk handling. Printing is another typical use for a word processor; we printed out a 45K-byte text document that consisted of 17 pages of 10-point text, and a more complex document with many font changes, a graphic, and double columns. Using the search-and-replace function to locate 10 occurrences of a phrase in the 45K bytes of text gave us a hint of how the products handle lengthy documents.

Finally, holding down either the cursor keys or the mouse button and scrolling from one end of the document to the other gave us some measure of the screen performance. The results are shown in the figure. Don't let the numbers influence you too much, though. The true test of a word processor is its ease of use, and on the Mac SE, most of the word processors were acceptable. The only package in this review that we judged acceptable on the Compaq Plus was BetterWorking Word Publisher 5.0. For anything else, we recommend a 10-MHz or faster 286 machine.

Functionality is harder to gauge, and

continued



PHOTOGRAPHY: PAUL AVIS © 1990

WYSIWYG WORD PROCESSORS

The WYSIWYG packages are divided into two groups; the PC packages are on the left, and the Mac packages are on the right. Only a few of the packages, such as Ami Professional and Microsoft Word, have a complete list of features (●=yes; ○=no).

Product name / **Price**	**Ami Professional 1.2** $495	**BetterWorking Word Publisher 5.0** $59.95	**InText 1.53** $295	**The Universal Word 1.5** $395	**WinText 1.54** $195	**Word for Windows 1.0** $495
Hardware needed	PC[1]	PC[2]	PC[3]	PC[4]	PC[5]	PC[6]
Editing						
Spelling checker	●	●	●	●	●	●
Thesaurus	●	●	○	●	○	●
Outliner	Limited function	●	○	○	○	●
Mail merge	●	●	○	○	●	●
Undo	●	○	○	●	●	●
Math functions	Tables only	○	○	○	○	●
Equation editor	○	○	●	○	○	●
Automatic timed save	●	○	○	○	●	●
Context-sensitive help	●	●	○	○	○	●
Draft mode	●	●	○	○	○	●
Maximum no. of windows	1	1 (2 files)	1	Memory-dependent	4	8
WP import formats	13	ASCII	ASCII	2	8	9
WP export formats	13	ASCII	ASCII	2	8	8
Long document features						
Create index/table of contents	●	●	○	○	●	●
Cross-referencing	●	○	○	○	○	●
Page marks	●	●	○	○	●	●
Customization tools						
Macro learn mode	●	○	●	○	○	●
Macro editor	●	○	○	○	○	●
Macro programming language	●	○	○	○	○	●
Customized main menu	○	○	○	○	○	●
Dynamic Data Exchange links	●	○	○	○	○	●
Groupwork editing						
Document notes	●	○	○	○	○	●
Strike-through	●	○	○	●	●	●
Document summary	●	○	○	○	○	●
Formatting						
Style sheets	●	●	○	○	○	●
Conditional page breaks	●	○	○	●	○	●
Widow/orphan control	●	○	○	●	○	●
Automatic hyphenation	●	●	○	○	●	●
Snaking columns	●	●	○	○	○	●
Side-by-side columns	●	●	○	○	○	●
Kerning and tracking control	●	○	○	●	○	●
Document queues	●	●	○	○	○	●
Prints in background	●	●	○	○	●	●
Graphics						
File formats imported	6	3	0	2	3	12
Sizes/crops/rotates graphics	●	Sizes	○	○	Sizes, crops	Sizes, crops
Moves graphics frames	●	●	○	○	●	Print-preview mode
Flows text around graphics	Drawing program	○	○	○	○	○
Page preview	●	Print mode only	●	○	●	●
Lines, boxes, borders	●	●	●	○	●	●
Drawing program	●	○	Polygon drawing	○	○	○
Table editor	●	○	○	○	○	●

Minimum system requirements:
[1] 286, 640K bytes of RAM, graphics card (Hercules, CGA, EGA, or VGA), DOS 3.0, mouse, and a hard disk drive.
[2] 8088, 512K bytes of RAM, graphics card, DOS 2.1, mouse for draw mode, and one floppy disk drive.
[3] 8088, 512K bytes of RAM, graphics card, DOS 2.1, two floppy disk drives, and a hard disk drive.
[4] 8088, 640K bytes of RAM, graphics card, DOS 3.0, and a hard disk drive.
[5] 8088, 512K bytes of RAM, graphics card, DOS 3.0, and a hard disk drive.
[6] 286, 640K bytes of system RAM, 1 MB of expanded RAM, graphics card (EGA or better recommended), DOS 3.0, and a hard disk drive.
[7] Mac Plus, 1 MB of RAM (2 MB recommended), a hard disk drive, and an 800K-byte floppy disk drive.
[8] Mac Plus, two 800K-byte floppy disk drives, and System 6.0.

for that we contrived a complex document typical of the applications for which you might use these word processors. Our test document had seven formatting changes. The text itself was set in two-column format, but the title on the first page was a single column of centered text. The first page also contained a 2- by 2-inch graphic, scanned at 300 dpi as either a TIFF-, PICT-, or PCX-format graphics file. Word processors unable to read any of those formats could get the image from the Clipboard in Windows or the Mac environment. In that case, the image resolution dropped to the standard screen resolution of 72 or 75 dpi.

More Than Just a Pretty Typeface

All the packages that we looked at have the basic word processing features and more. You can enter text, edit it, cut and paste, and search and replace—every writing function, with varying levels of ease. Most of these packages are rich in features. They have so many capabilities

	FullWrite Professional 1.1 $395	MacWrite II 1.1 $249	Microsoft Word 4.0 $395	MindWrite 2.1 $195	Nisus 2.11 $395	QuickLetter 1.03 $124.95	WordMaker 1.01 $124.95	WordPerfect for the Mac 1.0.4 $395	WriteNow 2.2 $199
	Mac[7]	Mac[8]	Mac[9]	Mac[10]	Mac[11]	Mac[12]	Mac[13]	Mac[14]	Mac[15]
	●	●	●	●	●	●	●	●	●
	●	●	●	○	●	○	○	●	●
	●	○	●	●	○	○	○	●	Format only
	●	●	●	○	●	○	●	●	●
	●	●	●	●	●	●	●	●	●
	○	○	●	○	w/macros	○	○	○	○
	○	○	○	○	○	○	○	○	○
	●	○	○	○	●	○	○	●	○
	○	●	●	○	●	○	○	○	○
	○	○	○	○	○	○	○	○	○
	Memory-dependent	7	22	Memory-dependent	Memory-dependent	10	10	Memory-dependent	Memory-dependent
	4	24	7	5	3	2	2	8	5
	2	24	7	4	3	2	2	7	5
	●	○	●	●	●	○	○	●	○
	○	○	○	○	●	○	○	○	○
	●	○	○	○	●	○	○	●	○
	○	○	●	○	●	○	○	●	○
	○	○	●	○	●	○	○	○	○
	○	○	●	○	●	○	○	○	○
	○	○	●	○	○	●	○	○	○
	○	○	●	○	○	○	○	○	○
	●	○	○	○	●	○	○	○	○
	●	●	●	○	●	○	○	●	○
	●	○	○	○	○	○	○	○	○
	●	○	●	○	●	●	●	●	○
	○	●	●	○	○	○	○	●	○
	●	○	●	○	●	○	○	●	○
	●	●	●	○	●	○	○	●	○
	●	●	●	○	●	○	○	●	●
	●	○	●	○	●	○	○	●	○
	●	Letter pairs	●	○	○	○	○	●	○
	○	●	○	○	○	●	○	○	○
	●	●	●	●	●	●	●	●	●
	3	8	PICT	PICT	PICT	PICT	PICT	PICT	PICT
	●	●	Sizes, crops	○	●	○	Sizes	Sizes, crops	Sizes
	●	●	●	○	●	○	●	○	○
	●	○	●	○	○	○	○	○	○
	●	●	●	○	●	●	○	●	○
	●	○	●	○	●	○	○	○	○
	●	○	○	○	●	○	○	○	○
	○	○	●	○	○	○	○	○	○

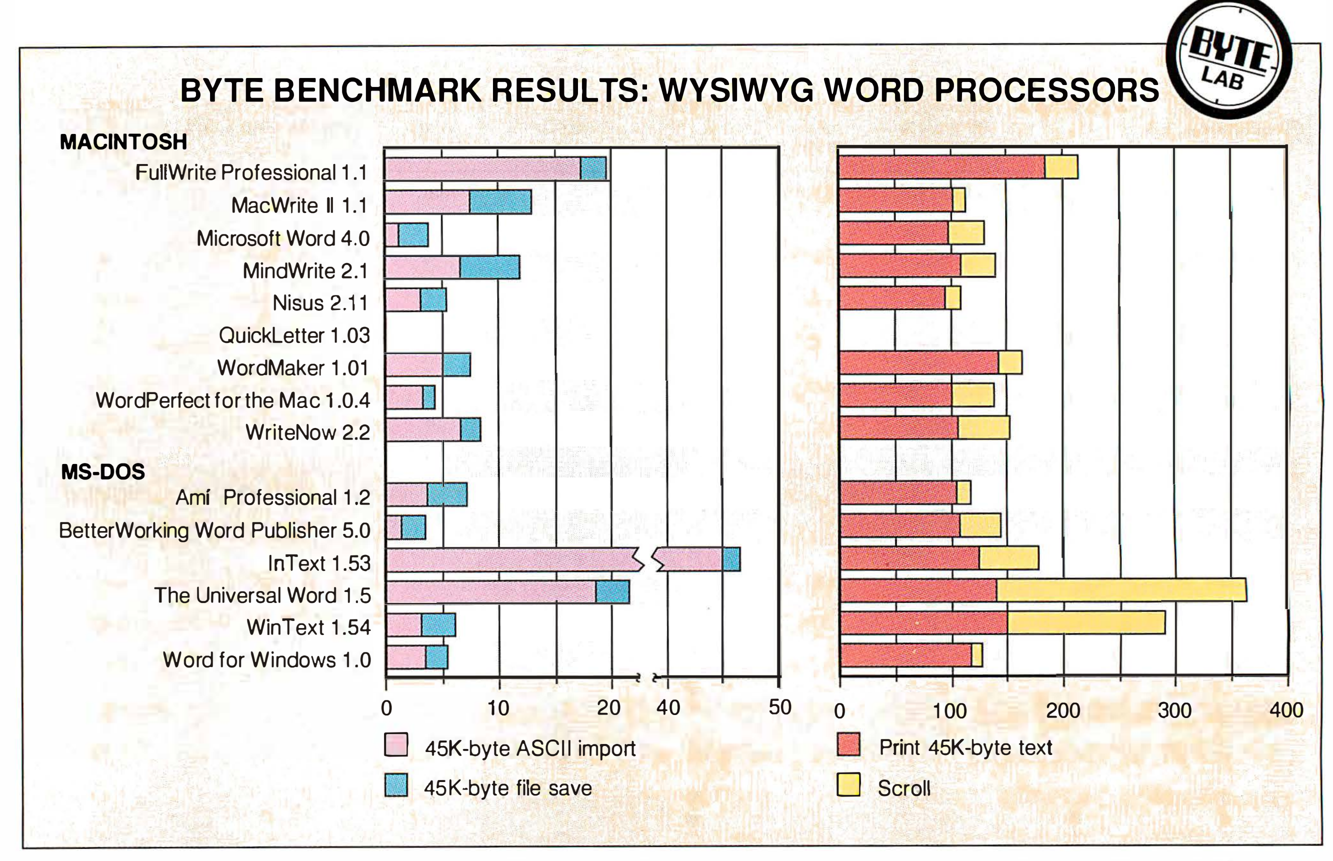
[9] Mac 512KE, two 800K-byte floppy disk drives, System 3.2, and Finder 5.3.
[10] Mac 512KE and two 800K-byte floppy disk drives.
[11] Mac Plus, 1 MB of RAM (2 MB recommended), and two 800K-byte floppy disk drives.
[12] Mac 512KE and one 800K-byte floppy disk drive.
[13] Mac 512KE, one 800K-byte floppy disk drive (a second 800K-byte floppy disk drive or hard disk drive is recommended), and System 4.1.
[14] Mac 512KE, two 800K-byte floppy disk drives, and System 4.1.
[15] Mac 512KE, one 800K-byte floppy disk drive, System 2.0, and Finder 4.1.

that we found it hard to try every feature on every package. If you're an average user, you will probably use only 80 percent of the capabilities of any particular WYSIWYG word processor. You'll design your own page style, pick a few fonts, and do most of your work using those few options.

We've listed all the major features available for all the WYSIWYG packages in the table above. For ease of comparison, we've separated the table into PC-compatible and Mac-based products. There is a difference in design philosophy between the PC and Mac products that in some cases prevents a direct comparison. For example, all the Mac products share the resources of the Mac OS, taking advantage of the general ease of moving data from one Mac product to another.

The PC packages that run under Windows can also share data with other

continued



Loading and saving files, printing, and text scrolling are the functions you'll use most often. BetterWorking Word Publisher was particularly quick with file I/O. Print speed is largely printer dependent. We tested the Macintosh products with a LaserWriter IINT; we measured the PC times on an HP LaserJet III with the PostScript cartridge. If your editing involves a lot of cutting and pasting, a fast scroll is essential—Word for Windows, Amí Professional, Nisus, and MacWrite II all did an exceptional job moving through text. QuickLetter could load only 31K bytes of the test file. The Universal Word printed in HP LaserJet mode, not PostScript. All times are in seconds.

applications; the non-Windows-based packages don't have that luxury. Mac product designers rely on the Macintosh's ability to automatically give their software access to data from every other Mac application. For that reason, people who design products for the PC have to incorporate more features than would be necessary on a Mac. On a Mac word processor, you can paste in a graphic that you drew in MacDraw. On a PC, if your word processor doesn't have a drawing package, you may have to live without fancy graphics. MultiFinder on the Macintosh provides background printing on LaserWriters to any application. Under Windows, the Print Manager/Spooler does the same for Windows applications.

Most of the packages use or provide a direct Mac or Mac-like environment. The work environment consists of a window with mouse and keyboard interface, pull-down menus, and function selection by clicking the mouse buttons. If you feel at home with the Mac, then all the Mac-based packages should be easy to learn. For those who are more comfortable with the keyboard, most packages do a fair job of mapping keystrokes to commonly used functions.

We tested the PC-based packages under both Windows 2.11 and Windows 3.0. Windows 3.0 is considered by most to be very Mac-like, and Amí Professional, Word for Windows, and WinText all use this to their advantage. The others? Well, the interfaces are a bit different.

The relative importance of each feature depends on the type of document you require. Most of these packages should prove more than adequate for memos, form letters, brochures, and contracts.

Amí Professional 1.2

With the release of version 1.2, Samna's Amí Professional fully supports Microsoft Windows 3.0 (see photo 1). There's simply no two ways about it—Amí Professional is a serious word processor. It has full word processing and editing capabilities; paragraph control with choice of fonts, alignment, and spacing; page-formatting control; and a spelling checker, a thesaurus, and an index and table of contents generator. Products such as Amí Professional and Word for Windows make the line between word processing and DTP a thin, gray one.

Amí Professional has the standard look and feel of a Windows application. It takes full advantage of all the Windows features, including Dynamic Data Exchange. With DDE, you can set up links between Amí Professional and Excel so that any changes made in the spreadsheet will update the Amí Professional document automatically.

File handling is another of Amí Professional's strengths. Besides handling the usual ASCII, it can import and export to or from most of the competitors' products. Amí Professional's index feature enables you to create multiple-level indexes. Go through your document and mark words that you want in the index. The program will then build an index or

continued

They Left out Features....
We Left out the COMMA!!

The only thing missing...

is the comma in the price. If you look at the chart on the right you will see prices charged by our competition. All but one contain a comma. DesignCAD 3D sells for $399.00. Period. No Comma!

In order to draw the complex pictures shown below it is desirable to have the following 3D features:

- **Interactive design with 3D cursor**
- **Blending of surfaces**
- **Boolean operations such as add, subtract, and intersection**
- **Complex extrusions**
- **Cross sectioning**
- **Block scaling**
- **On screen shading**
- **Shaded output to printers and plotters**

All of these competitors left out one or more of these desirable features in their standard package. They didn't forget the most horrible feature - the comma.

DesignCAD 3D offers **ALL** the listed features plus many more!

If DesignCAD 3D has the power to create the 3D objects shown below, imagine how it could help with your design project!

DesignCAD 3D sells for $399. We left out the comma. We didn't think you would mind!

PC MAGAZINE SAYS...

DesignCAD 3D, the latest feature-packed, low-cost CADD package from American Small Business Computers, delivers more bang per buck than any of its low-cost competitors and threatens programs costing ten times as much. For a low-cost, self-contained 3D package... DesignCAD's range of features steals the show."

$399

AutoCAD rel. 10	$3,000.00	AutoCAD AEC $1,000.00 AutoShade $500.00
CADKEY 3.12	$3,195.00	Solids $995.00 IGES translator $1,995.00
DataCAD with DC Modeler	$3,990.00	DataCAD Velocity $2,000.00
DesignCAD 3D ver. 2.0	**$399.00**	**NO expensive options! IGES Free, Shading Free**
MaxxiCAD 1.02	$1,895.00	N/A
Mega Model	$995.00	MegaDraw $195, List $295, MegaShade $395
MicroStation PC 3.0	$3,300.00	Customer Support Libraries $1,000.00
ModelMate Plus 2.8	$1,495.00	N/A
VersaCAD Design 5.4	$2,995.00	N/A

Source: Byte Magazine

BYTE MAGAZINE SAYS...

"At $399, DesignCAD 3D was the least expensive package we saw, yet it was one of the more powerful. ..Don't be fooled by the remarkably low price, this program can really perform."

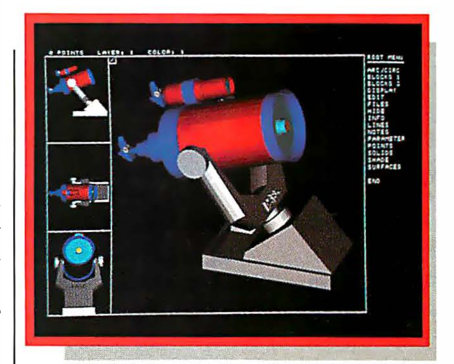
May 1989, page 178

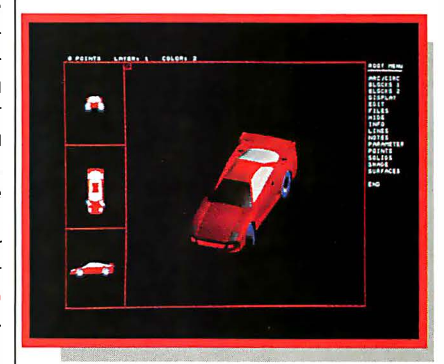
Complete 3-Dimensional design features make it easy for you to construct realistic 3-D models. With full solid-object modeling capabilities you can analyze your drawing to determine the volume, surface area or even center of gravity! DesignCAD 3-D even permits you to check for interference between objects! Aeronautical Engineers can now find the center of gravity for a new airplane design with a couple of keystrokes. The Architect can determine the surface area of a roof for decking in a matter of minutes. The Civil Engineer can calculate the volume of a lake or dam in seconds. The Mechanical Engineer will know for sure if certain parts fit together without interference. The uses for DesignCAD 3-D are only limited by YOUR imagination!

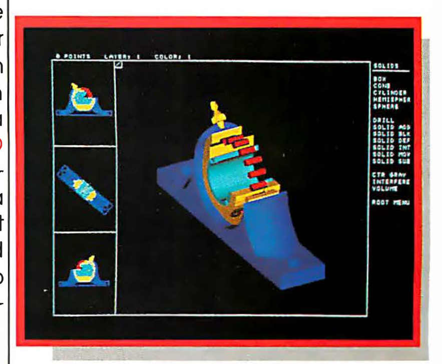
HOW DO I GET ONE?

DesignCAD 3-D and DesignCAD 2D are available from most retail computer stores, or you may order directly from us. If you have questions about which program to purchase please give us a call. All you need to run DesignCAD 3-D is an IBM PC or compatible computer with 640 K RAM memory and a hard disk. Both products support most graphics cards, printers, plotters and digitizers. Free Information and a demo disk are available by faxing (918) 825-6359 or telephoning:

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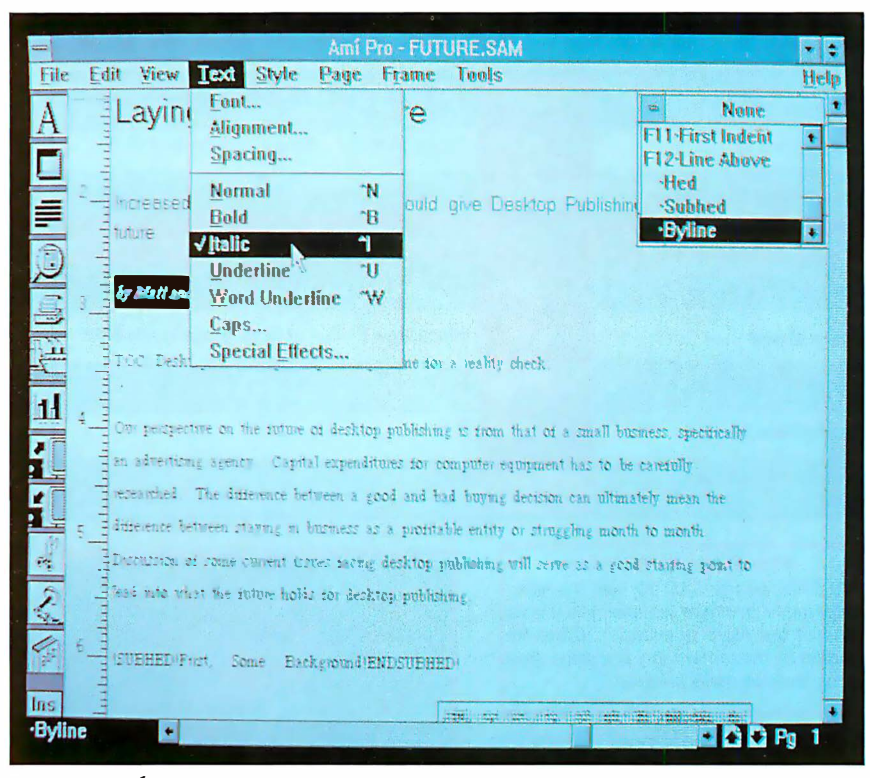


Photo 1: *Amí Professional under Windows 3.0 uses a menu structure that should feel comfortable to any Windows user. To select a type style or pick from a style sheet, you simply click and drag with the mouse.*

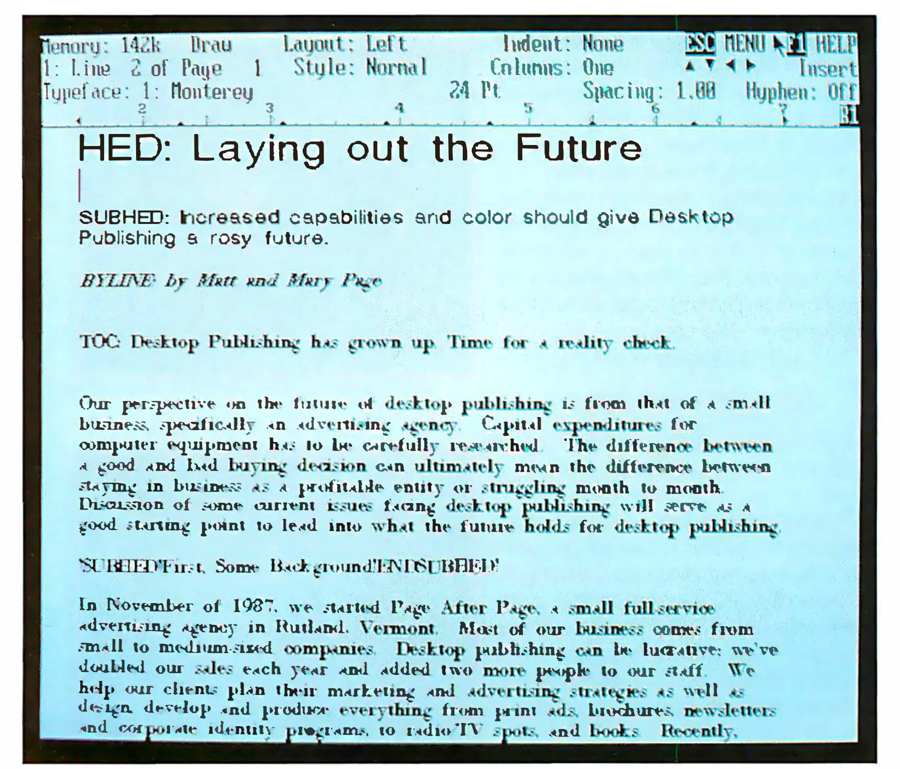


Photo 2: *BetterWorking Word Publisher's screen fonts, while low-resolution, give you a good idea of how your text will print. A status area at the top of the screen shows you pertinent setting, font selections, and the amount of available memory.*

table of contents, or cross-reference with page references to the appropriate words in the text.

Amí Professional gives you five different document views: a full-page view, a working view showing full lines of text, a standard view for size compatibility with other Windows applications, an enlarged view for examining fine details in small type or for visually impaired users, and a facing-page view for examining two pages simultaneously.

Like Word for Windows, Amí Professional has a particularly powerful macro language. With it you can automatically record keystrokes for performing almost any function. The keystrokes are saved in a macro command, and you can "play" the macro with a click of the mouse. The Amí Professional Macro Language is similar to BASIC in look and syntax.

Amí Professional is also well suited for groupwork editing. It offers document notes, a strike-through ability, and document summary. Style sheets allow you to save and reuse common document and font settings. The next time you format a document to be faxed, save the settings as a style sheet, and you'll never have to reformat a fax again. Samples include newsletters, memos, and press releases. Graphics support includes six graphics file formats: TIFF, Encapsulated PostScript, Lotus PIC, PCX, Windows Metafile, and Windows Clipboard. An object-oriented drawing package makes it easy to annotate text with geometric shapes.

Amí Professional carries a full-featured price tag, too. The retail price is $495.

BetterWorking Word Publisher 5.0

With a list price of $59.95, Spinnaker's BetterWorking Word Publisher 5.0 is the least expensive product in this review (see photo 2). Despite that, it's a true WYSIWYG editor, complete with various magnifications, full-page review, and support for different screen types (it does not run under Windows). It's not as fully featured as some of the other packages—but, again, it's not very expensive, either. It comes with an adequate outliner and support for an impressive array of printers.

Mouse support comes from the mouse manufacturer's driver; you install that first, and Word Publisher uses the mouse BIOS calls to get the screen location. The

continued

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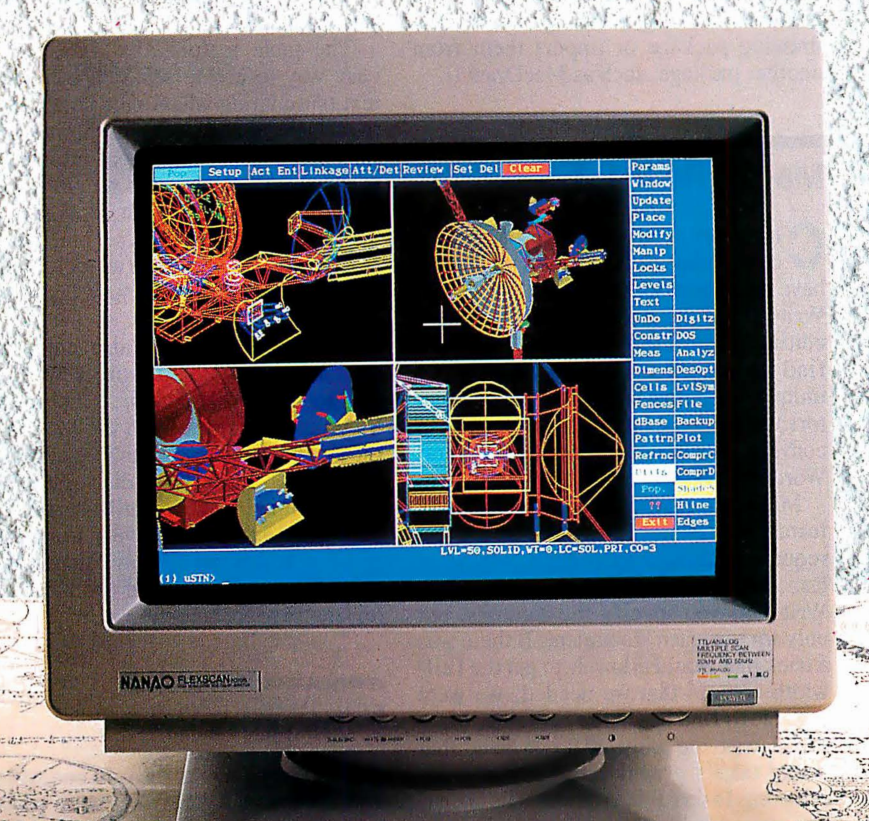
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Images created by Jerry D. Flynn, Design Engineer, McDonnell Douglas Space Systems Company, Kennedy Space Center, Florida.

screen display isn't as crisp as we'd like, but Spinnaker gives you a draft mode as well as WYSIWYG. In draft mode, the editor is blazingly fast; we found ourselves working in draft mode most of the time.

Importing a graphic and using a ruled line is simply a matter of switching to draft mode and typing in one of the special @ commands—in this case, `@picture d:\image.pcx p=(4.25) s=(2.5) a=2.75` did the trick. After the PCX format filename, the 4.25 specifies the distance in inches from the left margin. The figure 2.5 is the picture's width, and we wanted to have the text skip 2.75 inches, to avoid running into the image. It looks scary, but it takes just a minute or two to get it right. Ruled lines work in a similar way with the `horzline` instruction.

We found only one serious problem during testing. Word Publisher comes with both a LaserJet and a PostScript driver. We initially tested the LaserJet driver, and after it downloaded its own font set, Word Publisher did an incredible job with the text and the graphic. Next, we tried printing with Hewlett-Packard's PostScript cartridge. As we expected, the font support was superb.

Unfortunately, the graphic scrambled in a rather bizarre way. The image broke up into ¼-inch-wide horizontal bands, and then each band was flipped vertically. We then tried the graphic unsuccessfully on several other printers, among them Texas Instruments' MicroLaser with Adobe PostScript and an HP LaserJet Series II with Pacific Data's PacificPage (Phoenix's PostScript clone). Spinnaker's technical-support people say they have tested the PostScript driver only with an Apple LaserWriter; perhaps the old LaserWriter works differently than these newer printers. If you have a PostScript printer, check with Spinnaker before you buy Word Publisher. This should be an easy problem for Spinnaker to track down; perhaps it will be solved by the time you read this.

FullWrite Professional 1.1

FullWrite is a very rich package that suffers somewhat from a reputation for being too slow. True, it was noticeably slower than the rest of the Mac pack, but not in every test. On the Mac SE/30 there was never any occasion to worry about performance. Keystrokes will definitely lag behind a fast typist on the SE.

For $395, you expect a slew of features, and FullWrite won't disappoint you. As with all Macintosh products, there is the standard set—selection by click and drag, cut, paste, native/ASCII file save, and support for any system font in any style. To that, FullWrite adds an outliner, a hyphenator, a spelling checker, a thesaurus, and an index generator. The only obvious omission is a macro facility. If you're a macro junkie, a third-party macro facility, such as Affinity Microsystem's Tempo II, would be a good purchase.

One of FullWrite's most innovative features is Notes, which lets you pop up small windows of text or graphics and attach them to the main body. In these windows, you can store any additional information or comments about your main text. Sidebars give you the option of breaking the text into several pieces and laying the pieces side by side. In fact, that was how we managed to switch from one to two columns of text; putting the body of text in two-column format allowed us to treat the single-column title as a sidebar.

You can import bit-mapped images through the Clipboard, which normally restricts them to screen resolution. You create object images through the built-in drawing package or import them from another package, such as MacDraw II.

MacWrite II 1.1

Claris has finally provided a significant update to the MacWrite that we have all grown to know and love. MacWrite II has the standard complement of editing features that you would expect to find on the Mac. One of MacWrite's unique strengths is the Claris Translators, which come bundled. MacWrite can convert documents in Acta, Microsoft Word, WordPerfect, and other formats.

MacWrite II was unable to completely format our test document. Part of the test requires placing a full-width column of text above a two-column layout. MacWrite lets you specify the columns, but only for the entire document. If there was a trick that would allow us to get the full-width column that we needed, we were not able to find it. On the plus side, MacWrite was the only Mac product that would take a graphics file directly. By selecting Insert File from the file menu, you pick a PICT or MacPaint file directly and insert it at the current cursor position. The other packages require that you first move the file to the Clipboard and then paste it. By using the file directly, it's possible to import full 300-dpi bit maps. In our case, the graphic printed poorly, with no contrast and several lines sprinkled across the image. Images from the Clipboard were fine; it's the image scaling that didn't work.

Overall, we found MacWrite II a very satisfying product. It came in with the fastest time in the scroll test, a fact that was evident and appreciated as we used it. The performance in other areas was a bit disappointing, but MacWrite performed well where it counts. A mid-level product, MacWrite II sports a mid-level price tag: $249.

Microsoft Word 4.0

For $395, Word 4.0, for the Mac, easily qualifies as a full-featured word processor (see photo 3). It, too, has all the usual features that you'd expect, and others as well. Word's table functions make lining up grids and formatted tables a breeze. Simply tell Word 4.0 how many lines and columns you need, and it inserts a grid at the current cursor position. The mouse and tab key move you from cell to cell.

The table feature also gives you an easy way to create separate columns of text (simulating what other products call frames or sidebars). The sectioning feature breaks up a document into smaller sections, allowing you to set global attributes for each. The first section in our test document had one column, and the rest of the text was in a two-column format, so our test document layout was child's play.

Microsoft Word 4.0 also enjoys file compatibility with Microsoft Word 5.0 for the PC and Word for Windows 1.0. Moving documents from the Mac to the PC and back again couldn't be easier.

Word 4.0 for the Mac did wonderfully on our timed tests as well. Particularly impressive is the Fast Save option, which is very handy on floppy disks. Word ranks as the fastest Mac product in the review, save for screen scrolling.

MindWrite 2.1

MindWrite seems the odd one when it comes to WYSIWYG word processors. Formatted output is adequate, although not fancy. MindWrite limits you to a ceiling of 24 points on your typeface; there's no support for multicolumn text,

continued

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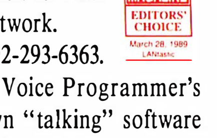
All of which led PC Magazine to conclude:

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Circle 28 on Reader Service Card (RESELLERS: 29)

and handling of imported graphics is limited. Nevertheless, MindWrite has a good outliner and a Clipboard function that allows you to cut and paste more than one item at a time. The result is that MindWrite seems crafted more for the creation of words than for their appearance.

Of all the word processors we looked at on the Mac, MindWrite has the easiest and most versatile outliner. You create a topic by simply typing new text; you make subsequent topics by pressing Return and typing more text. You make sublevels within a topic either by dragging text to the right with the mouse or by typing `Command-r` and typing text. If you want to exit a level and start a new topic, you either drag text to the left or type `Command-l`.

There's no limit to the number of sublevels a topic can have, and you can also select and drag sublevels to other parts of the outline, or even make them topics. MindWrite assigns either diamonds or numbers to items in the outline, depending on a user selection. If you're using numbers, they're automatically updated

continued

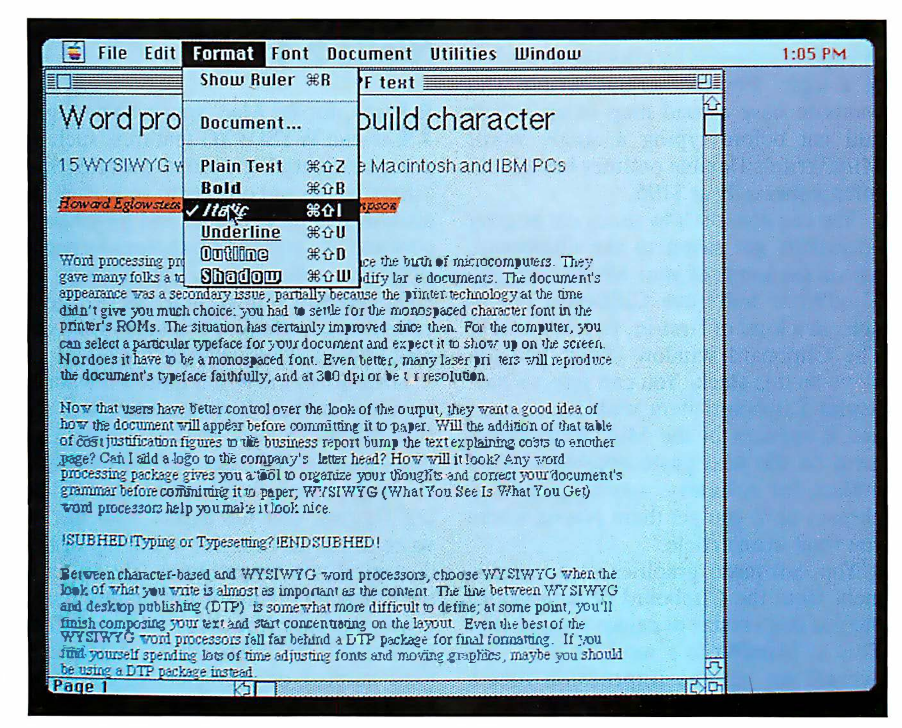


Photo 3: *The pull-down menus in Microsoft Word are typical of the Macintosh products in this review.*

as you change the outline. You can hide or expose sublevels by clicking to the left of a topic. For the serious writer who wants to have a road map of an article laid out before typing a single word, MindWrite's flexible outliner has a lot to offer, especially at $195.

You can also set how many cut or copy operations get saved to the Clipboard, within the limits of your Mac's memory. MindWrite will save Clipboard operations in a kind of first-in, first-out stack. The Clipboard window shows you the items on this stack. You can select a particular Clipboard item with the mouse, and it appears in the MindWrite document on the next paste operation. This makes for a handy way of juggling phrases until you get them placed where you want in an article.

You can paste graphics into a document from the Clipboard or scrapbook, but you can't resize or center the graphic. This is MindWrite's weakest area, but overall we get the impression that a MindWrite user is worried only about the contents of the text itself; someone else with a page layout application will worry about the text's form and style.

Nisus 2.11

Nisus, for the Mac, sports some higher-end WYSIWYG features, such as a sophisticated graphics palette that allows you to add objects to your page. It also has extensive header and footer support and lets you add footnotes to a page. However, although you can have up to eight columns of text, you can see these columns only within a print preview window—an odd omission, we think.

Nisus gives the writer quite a few tools to help with the job of writing. There's a user-selectable level of Undo operations (the default is 300) and 10 Clipboards for stashing choice swatches of text or holding figures. For the author who has to write to fit, an Info Bar at the top of the document window continuously displays the character count for the current paragraph and page (the default). This information can be modified to display the total number of characters or the total word count. A line-numbering function adds line numbers to the beginning of every text line. This function is handy for legal papers or for documents in which you have to reference something by line number—in, for example, an article proof faxed to an author.

Nisus's strong point is its editable macros. You create, edit, and use macros to perform repetitive operations. For example, if you want to keep certain gremlin characters in an imported text file (e.g., the formfeed characters), you can create your own macro that strips out all gremlin characters but those. An Easy-GREP and GREP facility allows you to do sophisticated pattern matching, including finding text that's in a particular typeface, style, or size. These latter features will be of use to advanced users, which makes Nisus more suited for technical documents. Nisus also costs a bit more than the less capable word processors: $395.

WinText 1.54

Palantir's WinText program has been around since the early days of Windows, long before anything else was available. As this article went to press,

Palantir had not yet announced Windows 3.0 support for WinText. We tested WinText under Windows' real mode, and it ran perfectly. Although its functions are limited, it's certainly adequate for simple word processing. And at $195, it was the least expensive of the Windows products we reviewed.

WinText reminds us a little of the original MacWrite: It offers only a spelling checker and basic editing features—insert, delete, cut, paste, and font selection. Before buying WinText, you might want to take a peek at Amí, Amí Professional's little brother. Amí lacks the professional version's thesaurus and drawing packages but retains much of the usability. Amí lists for $199.

Word for Windows 1.0

In April, we ran a comparative review of Word for Windows, Amí Professional, and NBI's Legend 2.0 ("Word Processing in Windows"). In that review, Lamont Wood found Amí Professional to be somewhat faster than Word for Windows under Windows 2.11. Using Windows 3.0, however, we found the opposite to be true. While both word processors are excellent performers, Word for Windows is a tad faster than Amí Professional under Windows 3.0 in real mode. In 386 extended mode, the difference is small enough that it's barely measurable.

Like Amí Professional, Word for Windows has full macro capability, style sheets, and various display modes. Draft mode gives you the entire text, unformatted, in a monospaced font for faster editing. Normal mode is full WYSIWYG, with the columns extended straight down the page for easier editing. Page mode moves the columns and graphics to their correct page positions. Word also includes a very easy-to-use outliner. Word for Windows' macro language is akin to BASIC, sharing the same constructs and many of the same keywords.

Word for Windows 1.0 holds its own against Amí Professional in most respects, even in price ($495). Perhaps the biggest difference between the two is Word's binary file compatibility with the Macintosh.

WordMaker 1.01

For basic editing needs, WordMaker is an inexpensive way to get into Mac word processing. For $124.95, you get standard Mac editing tools and a clean, professional interface. Simply running on a Mac gives a product a full-featured environment. Outside of that, WordMaker doesn't add any remarkable editing features, but it does include support for text in eight colors.

We had only two problems executing our test document: WordMaker doesn't handle multiple columns, and it won't wrap text around a graphic. It was simple enough to add extra carriage returns to make room for the image, but the other packages didn't require the extra step. To get the multiple columns, it would be easy enough to print out two thin columns and combine them on a photocopier—not a bad compromise.

WordMaker is ideally suited for people who don't need fancy columns and heavy formatting. Sometimes, it's best to get back to basics.

continued

WordPerfect for the Mac 1.0.4

The Mac version of WordPerfect is as full-featured and monolithic as the DOS version. As you'd expect, WordPerfect also saves files in DOS format. It was more difficult to feel comfortable with WordPerfect than with the other word processors, because the menu structure has a look and feel entirely its own. Pull-down menus are often arranged oddly, with the same feel as the DOS version's function keys. When you know that a function is "in there somewhere," an easy way to find it is to press the mouse button and scroll through the menus, looking for an entry that you remember. WordPerfect's extensive use of daughter menus makes that difficult, so you find yourself walking through, activating menu after menu, until you find the function you need.

Perhaps the unusual interface is a small price to pay for all that power. If you want both parallel and newspaper-style columns, no problem. If you like to nest macros within other macros, WordPerfect has you covered. It should be no surprise that WordPerfect had no problem with the test document formatting, once we found the necessary functions.

The documentation for this product is complete but hard to use. If you're a poor speller, think about what it's like to find the correct spelling for a word in the dictionary. If you know where to look for it, you can find it. But that would require knowing how to spell, and if you could do that, you wouldn't need to look it up. Welcome to WordPerfect documentation. The reference section is alphabetized by menu choice or concept, not by functionality. For example, the kerning capability lets you alter the spacing between individual characters. It's handy for giving a special look to a phrase, and we wanted to use it in the document title. On some products it's called "tracking"; on others, "character spacing." WordPerfect calls it "kerning" and puts the reference information by itself under *K*. We'd rather see it in a section of the manual in a discussion of the Format menu, listed in the order in which it appears on the menu.

If you opt for WordPerfect for the Mac, it will cost you $395. You won't be disappointed, but don't expect to use the reference manual as a learning aid.

WriteNow 2.2

WriteNow, at $199, is another package that prides itself on being a fast implementation of a minimalist Mac word processor. Like WordMaker, it provides the standard font support; select, cut, paste, and print functions; and a spelling checker and thesaurus.

A short function list makes WriteNow easy to learn and incredibly fast. Like WordMaker, WriteNow runs well on a single floppy disk drive and is a superb product for most editing needs.

Scratching That Niche

A few of the packages that we reviewed aren't really general-purpose word processors. Nevertheless, they are WYSIWYG, and they do the specific jobs for which they're intended.

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COMPANY INFORMATION

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(FullWrite Professional 1.1)
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San Jose, CA 95120
(408) 927-5154
Inquiry 1071.

Claris Corp.
(MacWrite II 1.1)
5201 Patrick Henry Dr., Box 58168
Santa Clara, CA 95052
(408) 987-7000
Inquiry 1072.

Delta Point
(MindWrite 2.1)
200 Heritage Harbor, Suite G
Monterey, CA 93940
(408) 648-4000
Inquiry 1073.

Huff Software
(InText 1.53)
2103 Farlow St.
Myrtle Beach, SC 29577
(800) 678-4833
Inquiry 1074.

Microsoft Corp.
(Microsoft Word 4.0,
Word for Windows 1.0)
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
Inquiry 1075.

New Horizons
(WordMaker 1.01)
P.O. Box 43167
Austin, TX 78745
(512) 328-6650
Inquiry 1076.

Palantir
(WinText 1.54)
4455 South Padre Island Dr.,
Suite 43
Corpus Christi, TX 78411
(512) 854-8787
Inquiry 1077.

Paragon Concepts
(Nisus 2.11)
990 Highland Dr., Suite 312
Solana Beach, CA 92075
(619) 481-1477
Inquiry 1078.

Samna Corp.
(Amí Professional 1.2)
5600 Glenridge Dr.
Atlanta, GA 30342
(404) 851-0007
Inquiry 1079.

Spinnaker Software Corp.
(BetterWorking Word Publisher 5.0)
201 Broadway
Cambridge, MA 02139
(617) 494-1200
Inquiry 1080.

T/Maker Co.
(WriteNow 2.2)
1390 Villa St.
Mountain View, CA 94041
(415) 962-0195
Inquiry 1081.

WordPerfect Corp.
(WordPerfect for the Mac 1.0.4)
1555 North Technology Way
Orem, UT 84057
(801) 222-4000
Inquiry 1082.

Working Software
(QuickLetter 1.03)
P.O. Box 1844
Santa Cruz, CA 95061
(408) 423-5696
Inquiry 1083.

WYSIWYG Corp.
(The Universal Word 1.5)
300 Corporate Point, Suite 410
Culver City, CA 90230
(213) 215-9645
Inquiry 1084.

InText 1.53

InText is a full WYSIWYG scientific word processor that can easily function as a full-featured text editor. It doesn't handle graphics or multiple columns. Otherwise, it does everything that you would expect from a full-featured word processor for $295.

The interface looks a bit dated, and it does not support a mouse. InText includes screen drivers for CGA, EGA, VGA, and Hercules displays. One of the more unusual features is a menu that serves to bind together the editor and print module. It's hard to describe, but suffice it to say that it doesn't conform to the standards that we've all come to expect from a modern software package. Plan on spending a few minutes getting the hang of it.

It's worth the effort. InText is a package clearly aimed at scientific and technical documentation. You enter mathematical expressions like any other piece of text; simply put them together with the equation editor, drawing any geometric shapes with the line-drawing tool. Special characters come from a special menu and can be resized to fit.

Speed isn't InText's forte. Beautiful text is, and the output quality was very impressive. HP LaserJet and PostScript drivers are included, as is support for most 24- or 9-pin dot-matrix printers. We recommend InText for any technical presentation, particularly those with mathematics or chemical symbols.

QuickLetter 1.03

QuickLetter is a Macintosh desk accessory that's ideal for occasional use or for hammering out a fast cover letter. In fact, QuickLetter comes with its own address book and special Print Envelope menu selection.

It's actually kind of fun—if you're in another word processor or database, you can select a name and address, find QuickLetter in your desk accessory list, and paste the address into a new document. Select Print Envelope, and bang out envelopes with no muss or fuss. It's also extremely handy to have a full multifont editor at your fingertips. There are many times in a telecommunication package that it would be convenient to grab a file from the disk, make text changes, and transmit the file without having to lose the connection and redial. Of course, there are shareware alternatives, but QuickLetter is a full word processor. Besides, the envelope and address book features are more useful than we would have imagined.

The package isn't expensive, either ($124.95), and that makes it all the more attractive.

The Universal Word 1.5

If there were a prize in this review for the prettiest screen display, The Universal Word from WYSIWYG Corp. would win hands down. We tested the English-only version of a product that is

continued



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clearly meant for multiple languages. For $395, you get English; for $695, you get some combination of English, French, Italian, Portuguese, Spanish, Dutch, German, Hungarian, Arabic, Russian, Swedish, Polish, and Farsi. Standard configurations have a specific subset; WYSIWYG will also custom-configure a set for your needs.

The version that we tested didn't support PostScript, and WYSIWYG is working on adding it. As a general word processor, we found The Universal Word to be rather slow. That doesn't mean it's not worth a look—far from it. If you need to handle multiple languages, The Universal Word might do better than anything else we looked at.

How to Buy a Word Processor

A word processor may be the most personal purchase that you'll ever make for your computer. Choosing between word processors is a bit like picking among religions, movies, or clothing styles; you will naturally gravitate toward one that "feels" right, which means that the word processor works the same way you do. You can ask your friends which ones they like, or you can read reviews in magazines. Just remember that you're not necessarily going to like the popular one or the one with the most features.

Are you planning on using your word processor to create newsletters? In that case, you won't care about counting words, retrieving foreign text files, or creating outlines. What you need for newsletters is a powerful formatting capability, preferably one with good graphics support.

Novice users may find the whole idea of a monolithic word processor much too scary. Let's face it: If you're using a word processor for day-to-day business correspondence, you're simply not going to use most of the features in a full-featured product. It's comforting to know that they're there, yet too many features can be confusing. So save some money and buy a simpler package with just the features that you'll use. In word processing, less is often more.

Sometimes you simply don't have a choice. In an office environment, it's likely that your network is made up of both Macs and PCs. In that case, it's handy to choose a word processor that works on both platforms and can share binary word processor files back and forth across platforms. In other cases, you need to share files with other users on the same platform.

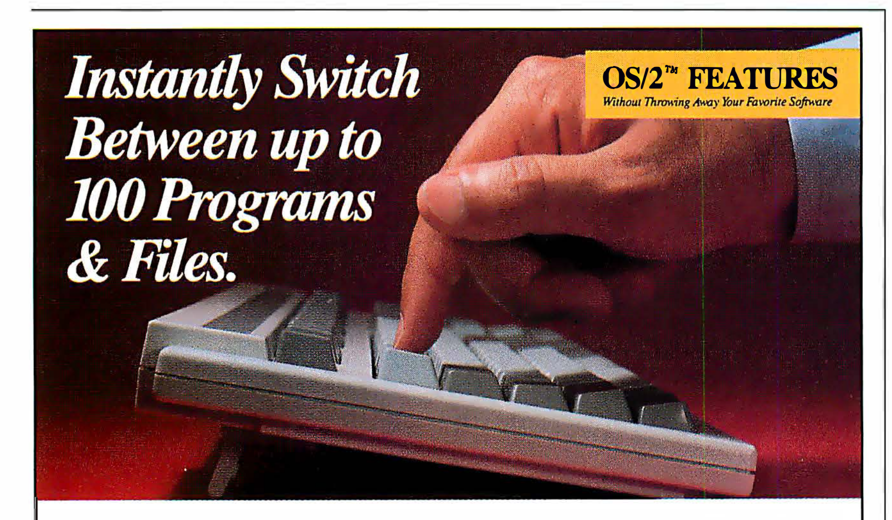
You might try borrowing a word processor from a friend or officemate and spending some time with it. Don't let anyone pressure you into using a full-featured package if you don't need it. Lastly, read the documentation. Some of the manuals in this review were difficult to use. For the popular products, many third-party books are available.

Kiss Your Typewriter Good-Bye

For the sort of editing that you might do in preparation for placing text in a DTP package, we liked Amí Professional and Word for Windows under DOS. Both have very good editing features and a draft editing mode. Choosing between the two is tough, but Amí's poor word-counting macro makes us lean toward Word. Word provides word and character counts as a standard item in its Summary Info box.

On the Macintosh, any of the word processors that we reviewed would suffice. If we were forced to pick one, we

continued



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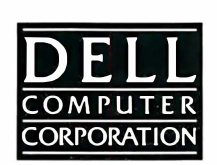
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would take MindWrite for its outliner or Nisus for its clever word counter and excellent macro language. MindWrite is a little thin on formatting features, but that's OK if the formatting is completed in a DTP package. It's responsive, and it has an outliner that nothing else could touch.

Some word processors do a superb job of formatting pages—particularly handy for doing newsletters. If not Amí Professional, try Word for Windows. If you want to save some money, the baby in this review, BetterWorking Word Publisher, is an amazingly capable package. Having fine control over your layout is somewhat more difficult with Word Publisher, but for a product that runs fine on floppy disk–based 8088 machines, it's downright awesome.

WYSIWYG is the Mac's realm, and, again, any product in this review would probably do the job. It was hard not to like Microsoft Word 4.0 and FullWrite Professional, although a more basic editor might be enough for most desktop publishing text preparation. In that environment, WriteNow's and WordMaker's lack of multiple-column support would be a nonissue.

The full-featured packages do feel somewhat stuffed with menu choices. It's likely that a novice at word processing would take one look at these big packages and head straight back for the security of the old typewriter. We would feel better about WinText if it was updated to run under Windows 3.0. InText was slanted toward scientific applications. Although it was not part of this review, Amí (Amí Professional's little brother), at $199, might be a good choice. It *has* most of Amí Professional's features, except for the thesaurus and drawing package. Windows doesn't provide the range of word processors that the Mac has had for years. In the Windows environment, it might be better to pick a full-featured product and ignore the features that you don't need.

Mac users have it much easier. Both WordMaker and WriteNow follow the Macintosh interface guidelines down to the last punctuation mark, and once you get them started, you instantly feel as though you have been using them for years. WriteNow comes with a thesaurus; WordMaker does not. If you don't want to be that basic, MacWrite II gives you the same ease of use, but with a bit more power, better file import/export capability, and a slightly higher price tag.

For mixed computing environments, 1Word (for Windows and the Mac) is an obvious choice. The two versions can easily transport documents back and forth across serial links or networks, preserving full formatting in the process.

If you're incorporating a Mac into a DOS WordPerfect shop, why not use the real thing? WordPerfect for the Mac is a superbly crafted product, and it does seamless translation to and from the DOS environment. If you're starting a mixed environment, Word might be better than WordPerfect, simply because the Windows and Mac versions are much closer in feel than the Mac and DOS WordPerfect versions. ■

Howard Eglowstein and Stan Wszola are testing editors/engineers for the BYTE Lab. You can reach them on BIX as "heglowstein" and "stan," respectively. Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson."

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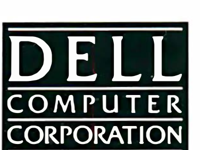
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SYSTEM

Tom Yager

REVIEW

DEC's Latest RISC



The DECstation 5000 packs some serious performance into a compact box. The expansion cabinet atop the main unit holds the hard disk drive.

DECstation Model 5000/200CX

Company
Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(508) 897-5111

Components
Processor: 25-MHz MIPS R3000 with 128K-byte cache; MIPS R3010 math coprocessor; LSI Logic LR3220 memory buffer controller
Memory: 16 MB of DRAM, expandable to 120 MB; 128K by es of static RAM cache
Mass storage: 665-MB SCSI hard disk drive
Display: 16-inch Sony Trinitron monitor; 32-bit DEC graphics adapter (displays 1024 by 864 pixels with 256 simultaneous colors)
Keyboard: DEC VT220-compatible
I/O interfaces: Three serial ports; thin-wire Ethernet port; SCSI port; video port; three Turbochannel expansion slots

Price
System as reviewed: $28,500

Inquiry 854.

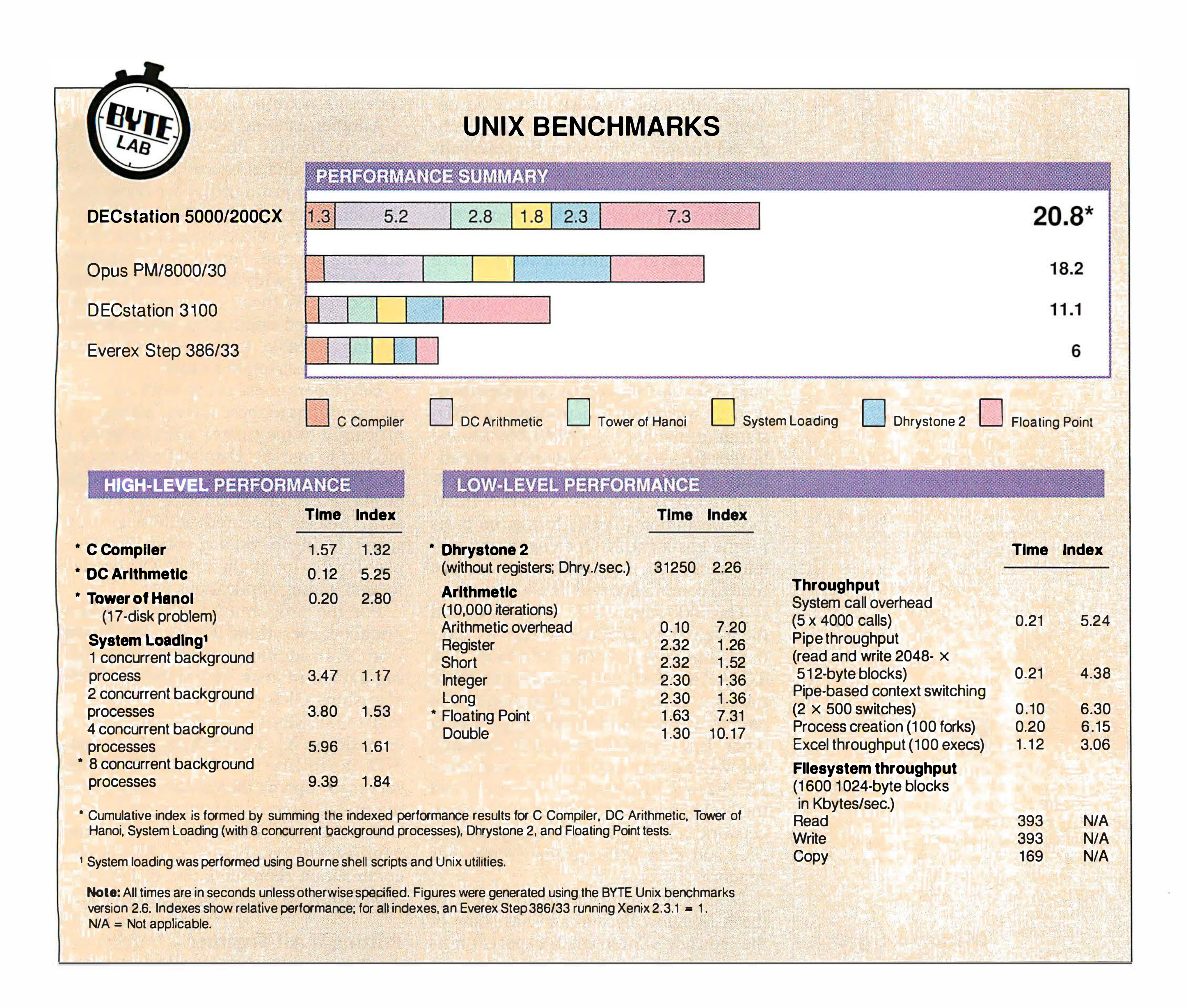
Walk into the temperature-controlled computer room of any university or Fortune 500 company, and you'll almost certainly see minicomputers from Digital Equipment Corp. As users like these have turned to smaller, less expensive machines, DEC has worked hard to diversify, introducing workstations such as its DECstation 3100 (see "DEC's RISC Powerhouse," November 1989 BYTE). DEC's newest entry, the DECstation 5000, offers the best desktop performance the company has to offer, and it illustrates DEC's increasing commitment to standards.

Despite this new system's kinship to earlier DECstations, the 5000 is much more than a rehash. The juice flows from a 25-MHz MIPS R3000 RISC microprocessor, backed by a 128K-byte static RAM cache. My review system, a Model 5000/200CX, came equipped with 16 megabytes of memory, an external 665-MB SCSI hard disk drive, and a copy of Ultrix, DEC's flavor of Unix. A 256-color, 1024- by 864-pixel graphics adapter drives the 16-inch Sony Trinitron display. The review system's list price came to $28,500; an 8-MB diskless (and displayless) system sells for $14,995.

The 5000 accommodates up to 120 MB of RAM and 21 gigabytes of disk space. Its SCSI connector lets you attach up to seven devices. Enhanced graphics options range from simple two-dimensional vector acceleration to a complex 3-D pipeline. The system unit is a sleek 3½ inches high, but the pizza box-size external hard disk drive doubles the total system height.

Driving the Turbocharged Bus

The 5000 incorporates DEC's new Turbochannel 32-bit bus architecture. This internal I/O channel routes data to expansion boards through three 44-pin slots. The Turbochannel specification lets the bus operate at any speed from 12.5 to 25 MHz; the 5000's bus cranks at full throttle. How fast is that? Claims like this are hard to prove, but DEC says



HIGH-LEVEL PERFORMANCE

	Time	Index
* **C Compiler**	1.57	1.32
* **DC Arithmetic**	0.12	5.25
* **Tower of Hanoi** (17-disk problem)	0.20	2.80
System Loading[1]		
1 concurrent background process	3.47	1.17
2 concurrent background processes	3.80	1.53
4 concurrent background processes	5.96	1.61
* 8 concurrent background processes	9.39	1.84

LOW-LEVEL PERFORMANCE

	Time	Index
* **Dhrystone 2** (without registers; Dhry./sec.)	31250	2.26
Arithmetic (10,000 iterations)		
Arithmetic overhead	0.10	7.20
Register	2.32	1.26
Short	2.32	1.52
Integer	2.30	1.36
Long	2.30	1.36
* Floating Point	1.63	7.31
Double	1.30	10.17

	Time	Index
Throughput		
System call overhead (5 x 4000 calls)	0.21	5.24
Pipe throughput (read and write 2048- × 512-byte blocks)	0.21	4.38
Pipe-based context switching (2 × 500 switches)	0.10	6.30
Process creation (100 forks)	0.20	6.15
Excel throughput (100 execs)	1.12	3.06
Filesystem throughput (1600 1024-byte blocks in Kbytes/sec.)		
Read	393	N/A
Write	393	N/A
Copy	169	N/A

* Cumulative index is formed by summing the indexed performance results for C Compiler, DC Arithmetic, Tower of Hanoi, System Loading (with 8 concurrent background processes), Dhrystone 2, and Floating Point tests.

[1] System loading was performed using Bourne shell scripts and Unix utilities.

Note: All times are in seconds unless otherwise specified. Figures were generated using the BYTE Unix benchmarks version 2.6. Indexes show relative performance; for all indexes, an Everex Step 386/33 running Xenix 2.3.1 = 1.
N/A = Not applicable.

that the Turbochannel's peak DMA performance is 93 megabytes per second.

The Turbochannel communicates with connected devices by exchanging messages. Each board receives a 4-MB chunk of address space (the top 32 MB of the system's 512-MB range is reserved), and commands and data pass through these memory-mapped regions. A proprietary protocol governs the format of these exchanges. DEC is making the protocol available to third-party vendors, along with the rest of the Turbochannel specification.

Internally, the Turbochannel does it all. All the outside-world interfaces deal with the CPU through an internal channel. The 5000's standard interfaces include thin-wire Ethernet, SCSI, and a trio of serial ports, one of which accepts the keyboard and mouse.

The Sony Trinitron display has become a standard among workstation vendors, and with good reason. The screen is cylindrical, giving it a flatter appearance, and the color rendition, sharpness, and image quality are impressive.

Of course, there's more to using a workstation than staring at the screen, and here the 5000 could use a little work. Like the DECstation 3100, the 5000 uses a VT220 terminal keyboard. That may make veteran users of DEC equipment happy, but I couldn't get used to the odd VT220 placements, which include relegating the Escape and Backspace keys to unlabeled function keys. The 5000 also comes with the same awkward mouse. It's round, heavy, and a tubby 3½ inches in diameter.

Bring On the BSD

Users who find the keyboard and mouse aggravating may take comfort in the Ultrix Worksystem Software bundle. The foundation for UWS (I tested version 2.2) is Ultrix, DEC's version of BSD Unix. BSD has earned a reputation as an environment for hackers, but DEC has added enough value to make it a

continued

For a description of all the benchmarks, see "The BYTE Unix Benchmarks," March BYTE.

contender for serious users as well.

Even System V users owe a lot to BSD: The C shell, the Berkeley socket network interface, the vi editor, and many other enhancements to Unix have their origins in BSD. These transplant well to System V, but it's good to work in an environment where all these things come together and combine with other Berkeleyisms that haven't yet found their way to System V. Little touches, like the intelligent TTY drivers (which can delete words and won't backspace past the beginning of a line) and the job control mechanism, are easy to get used to.

The base Ultrix operating system on the review system (version 3.1) combines the features of BSD 4.3 and AT&T System V Unix. The core environment is pure BSD, and the operating system handles all system administration in a BSD-standard manner. A set of libraries and header files provides System V compatibility and lets you port System V applications to Ultrix. Since the System V Interface Definition (SVID) forms the basis for the Posix and X/Open operating-system standards, DEC has smoothed the road to compliance with these standards.

The 5000 supports TCP/IP, NFS, and the proprietary DECnet through its standard thin-wire Ethernet interface. The TCP/IP and DECnet protocols can share the same cable, so the DECstation can be part of a network that includes not only other Unix workstations and systems, but VAXes, terminal servers, and other DECnet-specific devices. I quickly had the 5000 connected to BYTE's Unix lab network, and I had no difficulty sharing files and data with systems from other vendors.

DEC is active in the development of the X Window System and has some of the industry's foremost X experts on its payroll. So it's not surprising that the 5000's DECwindows graphical user interface is fast and clean. Beyond its X foundation, the environment created by DECwindows is quite comfortable.

DECwindows runs only on DEC hardware, but there's a lot to like about it. The interface is much more Mac-like than OSF/Motif's. It's mainly a monochrome interface; the defaults set up black and white as standard, even on a color display. Unlike Motif, DECwindows looks as good in monochrome as in color. But next to Motif, DECwindows looks boring. On closer inspection, however, the services that DEC has added to X put most other vendors to shame.

The session manager provides log-in services and adds a primitive desktop manager from which you can launch applications. One of those applications is `dxterm`, the DECwindows terminal emulator that's fast, stable, and robust. Without such programs, it's impossible to run text-based applications under X. The one that's shipped standard with X (`xterm`) is notoriously bad.

Another exciting feature of DECwindows is Display PostScript. Licensed from Adobe and enhanced by DEC, this is more than just a utility for displaying PostScript-format files. DEC has modified it to become an integral part of X, allowing programmers to mix traditional X functions with those from Display PostScript. Without it, X remains a severely limited application environment, lacking scalable fonts and a workable graphical description format.

Developers must often work up their own solutions to these issues, adding significantly to the time it takes to bring a product to market. Display PostScript on the 5000 responded well and managed to display every raw PostScript file I threw at it. Images appeared with surprising speed, laying to rest any notion that Display PostScript might not be fast enough for demanding applications use.

For the programmer, DEC provides just about everything that you could want from X. In addition to libraries for building DECwindows applications, DEC also ships GKS (Graphical Kernel System), OSF/Motif, and PEX (the PHIGS extension to X). The PEX package builds 3-D capability into X, extending the server to support the creation and drawing of 3-D objects. As mentioned, there is also support for building PostScript capability into applications. This killer combination represents one of the most powerful X software bundles available.

Putting It All Together

As the benchmark table illustrates, the DECstation 5000 has earned the flagship spot in DEC's line. It outguns its predecessor, the 3100, by a wide margin. Also interesting is the contrast with machines using another RISC processor, the Motorola 88000. While the 33-MHz Opus Personal Mainframe handily bests the 5000 in Dhrystones and other integer tests, in the domain of floating-point, the 5000 shows amazingly well.

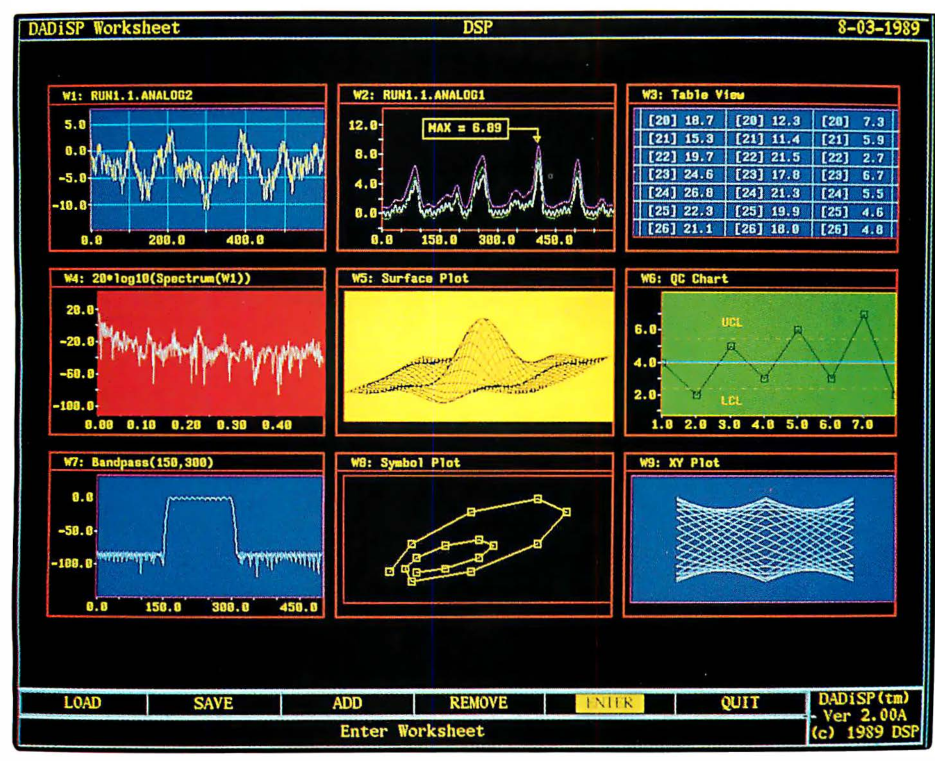
The DECstation 5000 is a top-shelf workstation. The excellence evident in performance, software, and company reputation combine to place this system at the head of its class. ■

Tom Yager is a technical editor for the BYTE Lab. You can reach him on BIX as "tyager."

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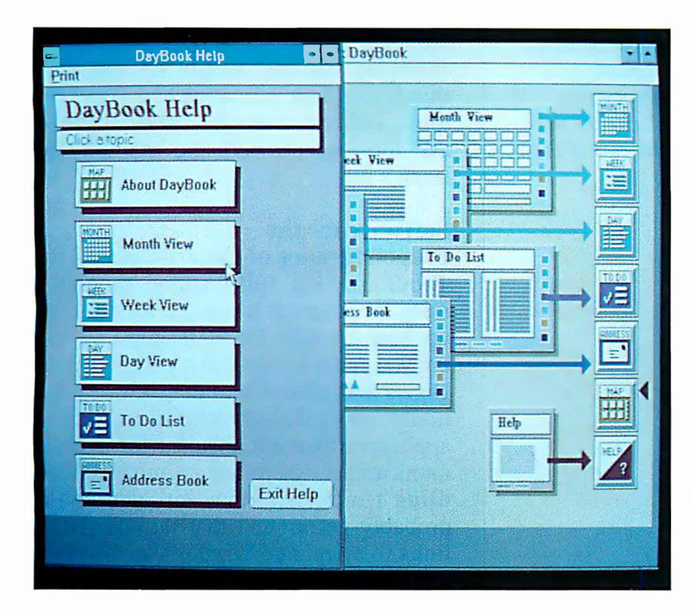
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Lamont Wood

REVIEW

Windows 3.0 Software Tool for End Users



ToolBook applications, such as DayBook, take full advantage of the Windows 3.0 graphical user interface.

Icon-based commands, buttons you "press" with the mouse, pop-up screens, data displayed in boxes—it's mouth-watering stuff. So mouth-watering that you had hoped someone might come up with a way to make such power accessible to the end-user programmer—in other words, to someone who wants to whip out a Windows 3.0 application this week, without having to spend two years learning C.

The answer might be ToolBook, a $395 package from Asymetrix, a little-known firm in close proximity (geographical and otherwise) to Microsoft. ToolBook provides that graphical programmability for Windows 3.0, and you don't need a degree in computer science to use it.

Yet ToolBook is not a crippled development system. For instance, ToolBook's programming language, OpenScript, has nearly 600 commands, constants, functions, and other keywords. You could make a career out of ToolBook, and I expect a lot of programmers will.

With ToolBook, an application is called a book. Each book is a stack of pages, and when you create an object (which ToolBook calls a container), it's akin to pasting a paper cutout on a clear sheet of gel. The bottom page is the background, and the contents of the foreground page are superimposed over it. You can rapidly flip pages, replacing one with the next. And, yes, you can do animation this way, placing slightly different pictures of the same thing in the same spot on successive pages and then flipping through them. The examples that come with ToolBook include a running horse, a sailboard in use, a turning globe, and balls bouncing around in the background of an application.

Besides animation, you can also create hypertext links to form automated footnotes. You can designate hotwords within text, and when you invoke the words, a linked body of text is displayed—presumably a definition or an exposition on a related subject.



ToolBook 1.0

Company
Asymetrix Corp.
P.O. Box 40419
Bellevue, WA 98004
(206) 637-1600

Hardware Needed
IBM PC or compatible with a 286 or higher processor, 640K bytes of RAM, at least 256K bytes of extended memory, a hard disk drive, Windows-compatible graphics, and a mouse

Software Needed
DOS 3.1 or higher; Windows 3.0 or higher

Price
$395

Inquiry 888.

Clearly, ToolBook parallels Apple's HyperCard toolkit for the Macintosh, with its HyperTalk programming language. HyperCard uses stacks of cards, while ToolBook uses books with pages. ToolBook, however, seems to have more features—for instance, it can handle color, and the size of its windows is not fixed.

With ToolBook, the book as a whole, plus each page and each object, can have its own script file, and each can pass commands to the others. Clicking on an object is not necessary—the mere presence of the mouse cursor atop an object can trigger an action, if that's what the script calls for. And you can assign books password protection.

There are two operating modes in ToolBook—reader and author. Reader is for running or testing applications, and author is for writing applications. Scripts are written on a special screen that you can invoke after selecting an object in author mode. The screen includes a syntax checker, and unlike with HyperTalk, there is a debugging facility with which you can add breakpoints to your program. In addition, there is a command window that you can invoke in author mode; from it, you can type individual OpenScript commands to test their results.

OpenScript, like HyperTalk, uses very English-like command words and syntax, and the meanings of many program lines are immediately apparent, such as `get the first word of the text of the recordfield comment` (using "the" is optional). You need to declare variables, but you don't have to worry about variable types—as long as a variable contains numeric data, OpenScript will perform numeric operations on it without fussing.

In keeping with the attempt to make programming seem natural, you can use the pronoun "it" as a local variable to refer to the last-mentioned data item, whatever it was. For instance, the programming example above could be followed by `put it into the commandwindow`, and OpenScript would understand. (HyperTalk also uses "it," but you don't see it used much elsewhere.)

Writing Your Own Book

To test ToolBook, I set out to write a file query application that would work with some dBASE data I had. The program

continued

Listing 1: *ToolBook's OpenScript isn't difficult to understand. This program goes through a dBASE file by repeatedly sending the* `buttondown` *condition to an existing subroutine for a button labeled Next (i.e., get next record). It also uses an existing system (global) variable from the main program called* `currentrecord` *(i.e., the current file record number). The variables are declared and set in the opening lines. Then, the first* `if...end if` *checks the first file record. The following* `do...until` *loop walks through the rest of the file. The ongoing total is displayed in a box called* `iresult`.

```
to handle buttondown

    local tot, total
    system svcurrentrecord
    set tote to 0
    set total to 0

    if text of recordfield code = "1"
            put text of recordfield amount into tote
            set total to sum(total, tote)
            put total into text of field iresult
        end if

    do
        send buttondown to button "Next"
        if text of recordfield code = "1"
            put text of recordfield amount into tote
            set total to sum(total, tote)
            put total into text of field iresult
        end if
    until svcurrentrecord=294


end buttondown
```

(see listing 1) filtered through a 294-record dBASE file with fields called Date, Amount, Code, and Comment, adding up the Amounts in the records where the Code field equaled 1.

I took advantage of the dBASE Browser Book that came with ToolBook and adapted it to my needs. To simply access the file and get the data on the screen, I had only to input the filename and then make about four mouse-clicks.

Then things bogged down. The script file for the Browser Book was long, complicated, and replete with calls to system-level subroutines or dynamic link libraries. Certainly, it didn't lend itself to tinkering. Using its subroutines from a script for a particular button proved workable, but then the second problem arose—OpenScript looks like English, but it isn't.

After all, it's easier to read a foreign language than to write it. When it comes time to write something, a novice is likely to foul up the grammar—but a reader may still figure out the meaning, thanks to common sense. Computers, however, lack common sense. The result is like constantly repeating a magic spell to a genie who will not respond until you get it precisely right.

Of course, this is true with every programming language. However, in the case of OpenScript, the language seemed so natural that I was constantly ambushed by sticky little points: `Put the text of recordfield comment into it` will work, while `put the text of recordfield comment in it` or `put recordfield comment into it` will not. Using the command window to test commands became essential—slowly, I learned the dialect.

And once you learn it, there's little the Windows 3.0 world offers that is not at your disposal. You can add scroll bars to text displays. You can run other programs, including other "instances" of ToolBook, from within ToolBook. You can change the shape of the cursor, make use of whatever fonts are installed in Windows, use colors at will, have bar graphs that draw themselves as the data is totaled, and so on. You can even do Dynamic Data Exchange (DDE) links, although there is no mention of Structured Query Language.

In author mode, ToolBook has a graphics facility so that you can draw screen objects. Thus, screen objects can be irregular—for instance, to get information on Idaho, you could click anywhere in a map of that state. In HyperCard, you can stack a map of Idaho with a button, but you would still have to click the button within the map rather than just the map.

The program also comes with a selection of canned clip art for livening things up, including the 16 different drawings of the globe used for the turning-world animation. There are a tutorial, extensive help files, interesting programming examples, canned scripts for handling things like data validation and Windows tools, and two manuals. There's little to ask for—except, perhaps, the time to learn it all.

Software for the Preponderance of Us

ToolBook is a full-featured programming language. It's suitable for cooking up user-friendly business applications, but you can also use it to create elaborate games and educational courseware. Actually, about the only kind of interactive application that it's unsuited for is communications—there are no modem-handling functions. However, you could probably get around that through DDE links to a separate Windows-based communications package.

Perhaps ToolBook's fate is to become as ubiquitous in the PC world as HyperCard is in the Macintosh world. Consider that Asymetrix was founded by Paul Allen, previously known for having co-founded Microsoft (maker of both MS-DOS and Windows) with Microsoft's present head, Bill Gates. Allen left Microsoft around 1983, but Asymetrix's funding was secured by Allen's equity position in Microsoft, and Allen was recently renamed to the Microsoft board of directors. Meanwhile, Microsoft has announced that a run-time version of ToolBook (with a ToolBook application called DayBook) will be included with each English language copy of Windows 3.0. And Microsoft Press has come out with a guide called ToolBook Companion.

Basically, ToolBook has Microsoft's clout behind it, and you might as well think of ToolBook as part of the Windows 3.0 environment. Now that you have a Windows that lives up to its potential, you can think of Windows 3.0 as part of the PC environment. So you're likely to see a lot of ToolBook.

One thing that you are sure to see a lot of is powerful, Windows-based applications, whether for a single chore for an individual user, for departmental applications, or for sale at the national level, because the tool is definitely available. ■

Lamont Wood is a freelance computer journalist and consultant who lives in San Antonio, Texas. He can be reached on BIX as "lwood."

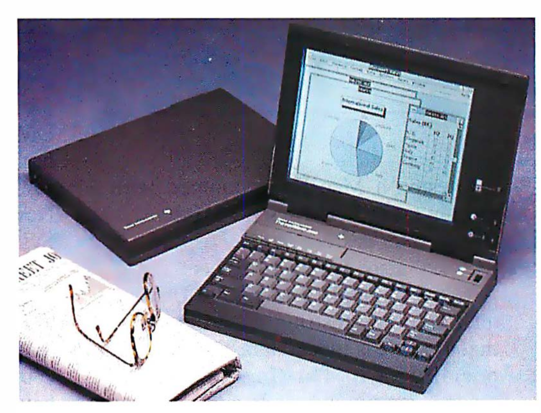
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Circle 292 on Reader Service Card

Tom Thompson

REVIEW

The Mac at 40 MHz



Paired with Apple's 8•24 display board, the high-performance Mac IIfx soars as a personal workstation.

Mac IIfx

Company
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

Components
Processor: 40-MHz Motorola 68030; 40-MHz Motorola 68882 math coprocessor
Memory: 4 MB of 80-ns SIMM DRAM
Mass storage: 3½-inch 1.44-MB SuperDrive; 80-MB internal SCSI hard disk drive
Display: 13-inch 640- by 480-pixel AppleColor RGB monitor; Macintosh Display Card 8•24 24-bit color NuBus board
Keyboard: 63-key standard keyboard
I/O interfaces: 2 mini-DIN-4 ADB ports; two mini-DIN-8 RS-232C/RS-422 serial ports; DB-25 SCSI connector; internal SCSI connector; internal floppy disk drive port; stereo sound port

Price
$11,896

Inquiry 851.

If you measure power by clock speed, Apple's Macintosh computers always seem to come up short. Even the Mac IIci putters along at 25 MHz, versus many 386-based PCs' 33 MHz. The newest member of the Macintosh modular family, the Mac IIfx, changes that.

The Mac IIfx's 68030 CPU and 68882 FPU race along at 40 MHz; I/O processors off-load serial, mouse, and floppy disk drive activities; and a much-needed 32K-byte cache of fast RAM boosts performance. (For more information, see the First Impression "Apple's Special fx," April BYTE.) No doubt PCs soon will run at this speed, but that doesn't diminish the fact that the IIfx got there first, doing what the Mac does best: providing a consistent user interface, seamless data exchange, and gorgeous 24-bit color graphics.

I tested a Mac IIfx equipped with 4 megabytes of RAM, an 80-MB hard disk drive, and a Macintosh Display Card 8•24. I also evaluated a beta copy of A/UX 2.0, Apple's version of Unix. After extensive testing, I've determined that the IIfx is indeed a fast machine, especially in its floating-point performance. Combined with A/UX 2.0, the IIfx becomes a powerful Unix machine.

Taking It Out for a Spin

During its design, the IIfx carried the code name F-19. BYTE Lab tests show that the IIfx performs like its jet fighter namesake: The machine flew through most jobs with its afterburners on. The CPU and memory subsystems run about 60 percent faster than those of the Mac IIci, reflecting the increase in the IIfx's clock speed. The FPU subsystem's number-crunching power has doubled.

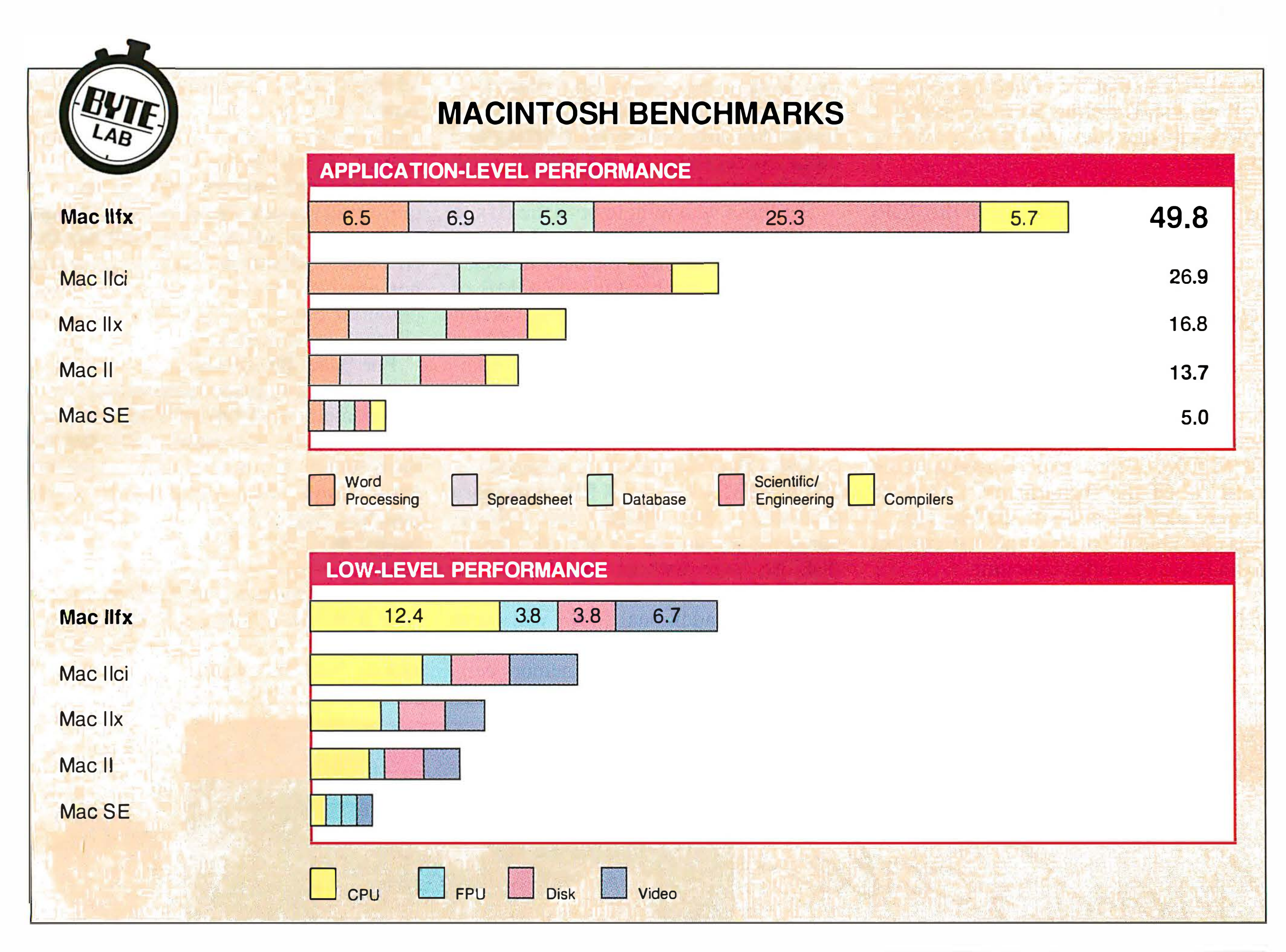
I was disappointed, however, with the disk I/O subsystem tests. Where the test made heavy use of the CPU, performance jumped, while purely disk-intensive jobs showed little improvement over the IIci. True, the IIfx can use SCSI DMA to improve disk I/O throughput, but the current version of the Mac OS (6.0.5) doesn't make use of this feature. Nor, it turns out, will the long-awaited System 7.0.

SCSI DMA requires a preemptive multitasking operating system to function properly (i.e., to release the CPU so that it can carry out other tasks). System 7.0, unfortunately, still uses MultiFinder for cooperative multitasking. Since Unix is a preemptive multitasking operating system, it's ironic that for now only A/UX users stand to benefit from this feature. Fortunately, A/UX 2.0 promises to look more like a Mac than you might expect (see "A/UX 2.0: Unix with a Friendly Face," August Short Takes).

Hex, Lies, and Backup Tape

Not long after the IIfx's introduction, rumors of major software incompatibilities

SCREEN: JET FIGHTER FILE COURTESY OF DENEBA SOFTWARE



Except for the conventional benchmarks, all results are indexed; for each test, a Mac SE = 1, and higher numbers indicate faster performance. In the Dhrystone test, higher numbers indicate faster performance; in the LINPACK tests, lower numbers are better. The floating-point benchmarks use the SANE library. Comprehensive test results for all tested machines are available on request.

CONVENTIONAL BENCHMARKS

	LINPACK (single)	Double LINPACK	Dhrystones
Mac IIfx	125	116	10,752
Mac IIci	150	151	5725
Mac IIx	233	241	3680
Mac II	364	348	2861
Mac SE	2319	4229	805

cropped up. This was inevitable, as the new IIfx design consolidated more functions into custom application-specific ICs. During this process, registers disappear and I/O addresses change, causing software that's hard-coded for a particular hardware setup to break. Applications that stick to using Mac Toolbox and OS calls don't have problems, since these calls are hardware-independent.

To investigate these rumors, I tested a large number of applications. Most of the debuggers worked—an amazing feat, considering how close they operate to the hardware. Jasik Designs' MacNosy and Debugger V2, the premier industrial-strength disassembler and debugging package for the Mac, functioned just fine, as did Icom Simulations' TMON 2.8.4 debugger. Some graphics software, such as Adobe Illustrator 1.9.3 and PhotoMac 1.1, crashed; they couldn't deal with 32-Bit QuickDraw, which Apple has embedded in the IIfx's ROMs. This isn't a new problem: Users first encountered it with the Mac IIci. The solution is to get an upgrade from the application vendor (Illustrator 1.9.5 and PhotoMac 1.52).

More serious problems surfaced with software that hammered directly on the Mac IIfx's serial and Apple Desktop Bus ports, or the Super Wozniak Integrated Machine (SWIM) controller for the floppy disk drive. The I/O processors (IOPs) that manage these devices get in the way of these programs and cause trouble. Farallon's SoundEdit had mouse-handling problems (from IOP interaction with the ADB signals), and a beta version of Adobe Photoshop using key-disk copy protection crashed when the application asked for the disk (from IOP interaction with the floppy disk drive controller, and a case against copy protection if I ever saw one).

I normally use Traveling Software's LapLink Mac III to rapidly transfer the 8

continued

For a full description of the Mac benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

MB of benchmark files from one Mac to another via a serial cable. Not this time, though: Launching LapLink caused the IIfx to seize up. Apple now supplies a Compatibility cdev that reroutes the serial data so that the offending software still works. Traveling Software supplied a disk with this cdev, and it corrected the problem.

I suspected that telecommunications software might be a casualty of this IOP/ serial port interaction, but I'm pleased to report that I was wrong. White Knight 11.07 let me connect to BIX and download files without a hitch, as did Mac-Acknowledge 1.02 and America Online's software.

I tried some SCSI peripherals to check for SCSI hardware interaction. An Apple scanner worked, as did Apple's CD-ROM drive. (Apple experienced a minor gaffe when the then-current CD-ROM driver failed to work with the Mac IIci.) I was also able to back up and restore files to an Irwin cartridge tape unit.

High Flyer

The IIfx's processing power makes it useful as a CAD workstation. AutoCAD release 10 c5 whipped through displaying the sample files, making real-time CAD work possible. This is also the image-processing engine I've always wanted in a Mac. Adobe Photoshop 1.0 and Data Translation's PhotoMac 1.52 both inhaled megabytes of 24-bit TIFF image data and performed filtering and color corrections on the images with amazing speed.

For those who want to push the IIfx to the limit, there is Connectix's Maxima. It's an INIT that maps memory in such a way that you can have up to 14 MB of RAM for your applications (the normal limit is 8 MB, because of where the Mac ROMs reside in memory space). Additional memory gets allocated to a RAM disk.

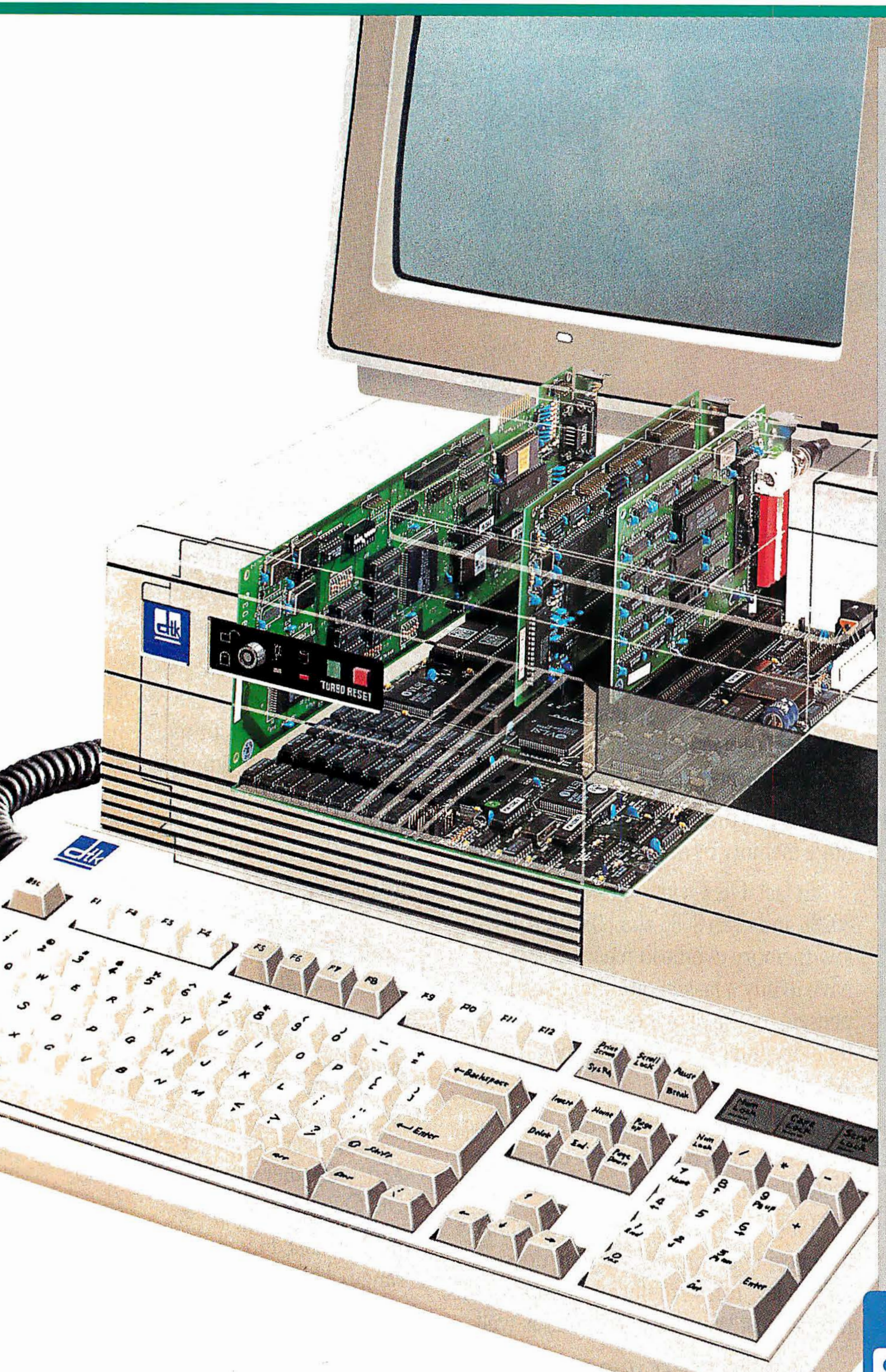
I used 4-MB single in-line memory modules from Connectix to upgrade my IIfx to 32 MB. I made 14 MB of memory available to MultiFinder, and I designated the remaining 18 MB as a RAM disk. So, even without A/UX, you can still get lots of memory for your work. And all that additional RAM will come in handy when System 7.0 arrives, since it will eliminate the 16-MB memory ceiling that the existing 24-bit Mac OS has imposed.

My only complaint about the Mac IIfx is its price. A basic system with 4 MB of RAM, an 80-MB hard disk drive, and a 13-inch color monitor and 256-color board costs $11,896. Admittedly, you aren't going to buy a IIfx for word processing. It will be for demanding CAD, business, and engineering jobs that require every clock cycle that you can afford. In short, many people will buy the IIfx as a workstation. But even from this perspective, the price is steep, and many potential buyers might shop around for alternative workstations.

For Mac IIx owners, the cost of a motherboard upgrade ($2999) and 4 MB of IIfx memory ($999) will buy into Mac IIfx power at a reasonable price. But for the rest of us, if you need the most powerful computer that Apple has to offer, you had better have your checkbook handy. ■

Tom Thompson is a senior editor at large with a B.S.E.E. degree from Memphis State University. He can be reached on BIX as "tom_thompson."

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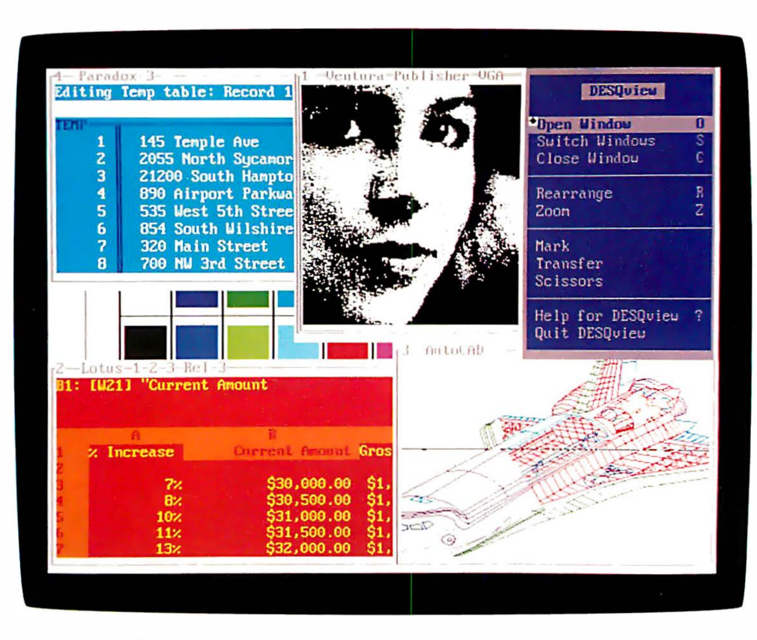
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	QEMM-386 version 5.0	❑			$99.95	
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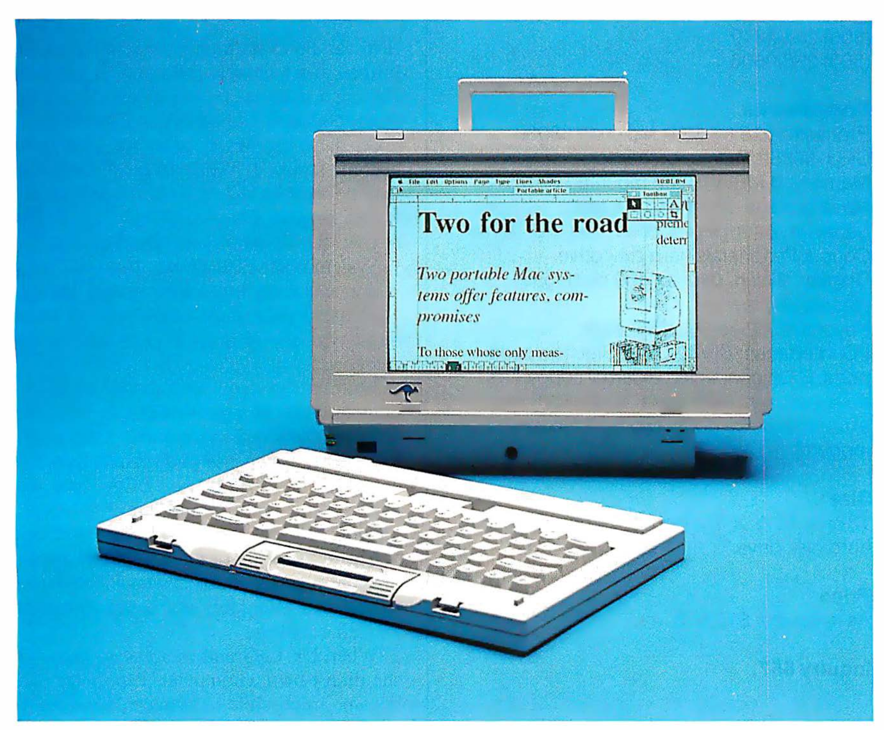
Circle 35 on Reader Service Card

SYSTEM

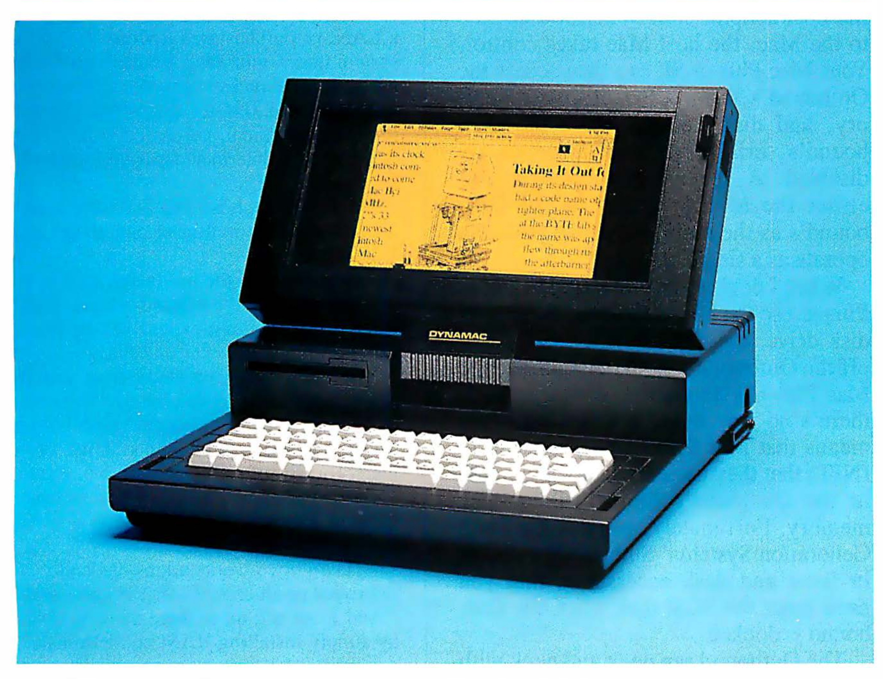
Laurence H. Loeb

REVIEW

Two Different Approaches to Mac Portability



The Outbound performs comparably to the Mac Portable, but it needs the ROMs from your Mac Plus or SE to operate. Note the IsoPoint pointing device below the space bar.



The Dynamac SE/30 offers uncompromising performance in a hefty 18-pound box.

In introducing the Mac Portable last year, Apple succeeded in freeing the Mac from its power outlet, but many users found the machine underpowered and overweight. Fortunately for those who don't want to leave their Mac applications behind when they travel, the Mac Portable isn't the only game in town: Outbound Systems' Outbound Laptop System offers comparable performance in a lighter box, and Dynamac's SE/30 will appeal to users for whom portable power is critical.

Mac Light: The Outbound

Outbound Systems markets the Outbound Laptop System (formerly the Wallaby) as a hardware add-on to a Mac Plus or SE. This conceptual paradigm bypasses the issue of ROM usage that is vital to the Outbound's operation: Your dealer must transfer the needed Apple ROMs from your Mac Plus or SE to the Outbound. The now-ROMless Mac will not operate unless you "dock" the Outbound to it using a special cable.

The Outbound uses the same 15.67-MHz CMOS 68000 CPU as the Mac Portable, but it costs substantially less. The 9¾-pound plastic lunchbox case is also much lighter than the 16-plus-pound Portable. My review unit included an internal 3½-inch floppy disk drive that can use IBM- or Mac-formatted floppy disks. The machine has only one drive bay, however, so users who opt for the internal 40-megabyte hard disk drive must forgo an internal floppy disk drive.

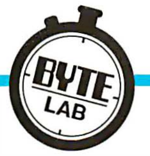
My review machine included 2 MB of RAM (expandable to 4 MB) and 4 MB of battery-backed RAM in single in-line memory modules for the nonvolatile RAM disk. You can expand the silicon disk to 16 MB using 4-MB SIMMs. The base system, with 1 MB of RAM and no RAM disk, has a list price of $2999; the hard disk drive model is $3999. Outbound doesn't sell extra RAM.

Fluorescent backlighting in the Outbound's 640- by 400-pixel black-and-white LCD ensures visibility in low-light situations where the Mac Portable is unusable; in other respects, the Portable's active-matrix LCD is superior. LCD latency times on the Outbound produce smearing on fast-moving text or graphics screens, and finding the cursor can be problematic. When I jiggled the mouse, the cursor disappeared; at rest, the thin I-bar cursor is hard to see. Adjusting the screen contrast helps somewhat.

The Outbound's lead-acid battery provides about 3½ hours of power. Power conservation functions include Control

continued

REVIEW TWO DIFFERENT APPROACHES TO MAC PORTABILITY



Outbound Laptop System

Company
Outbound Systems, Inc.
4840 Pearl East Cir.
Boulder, CO 80301
(303) 786-9200

Components
Processor: 15.67-MHz Motorola MC68C000
Memory: 2 MB of RAM
Mass storage: 3½-inch 1.44-MB internal floppy disk drive; 4-MB battery-backed silicon disk, expandable to 16 MB
Display: 9¾-inch, 640- by 400-pixel, backlit, black-and-white LCD
Keyboard: 62-key Mac SE-type layout with IsoPoint pointing device
I/O interfaces: Printer port; serial port; external monitor port; host connector/ expansion port for optional SCSI adapter

Size
12⅓ × 7⅘ × 3⅗ inches; 9¾ pounds with battery and hard disk drive

Price
System as reviewed: $3499

Inquiry 856.

Dynamac SE/30

Company
Dynamac Computer Products, Inc.
555 17th St., Suite 1850
Denver, CO 80202
(800) 234-2349
(303) 296-0606

Components
Processor: 15.67-MHz Motorola 68030 CPU; 68882 math coprocessor
Memory: 8 MB of SIMM-mounted RAM
Mass storage: 3½-inch 1.44-MB SuperDrive floppy disk drive; 200-MB 16-ms Conner Peripherals hard disk drive
Display: 9-inch, 640- by 400-pixel, gas-plasma display
Keyboard: 62-key Mac SE-style
I/O interfaces: SE/30 Direct Slot; two serial ports; SCSI connector; external floppy disk drive port; two ADB ports; audio port; two external monitor ports; two RJ-11 jacks (on modem)

Size
13½ × 15½ × 3½ inches; 18 pounds with hard disk drive

Price
As reviewed: $12,995

Inquiry 857.

Panel settings that invoke CPU sleep mode, dim backlighting, and spinning down the hard disk drive when the machine is idle.

The keyboard uses the standard Mac SE layout, without the numeric keypad. It can attach to the case or stand alone when in use. Remote keyboard connections include an infrared link and a telephone-style cord. You attach the keyboard to the Outbound with a metal rod that fits into a hole under the screen. I found that the mechanical linkage in this arrangement made the keyboard wobble unacceptably.

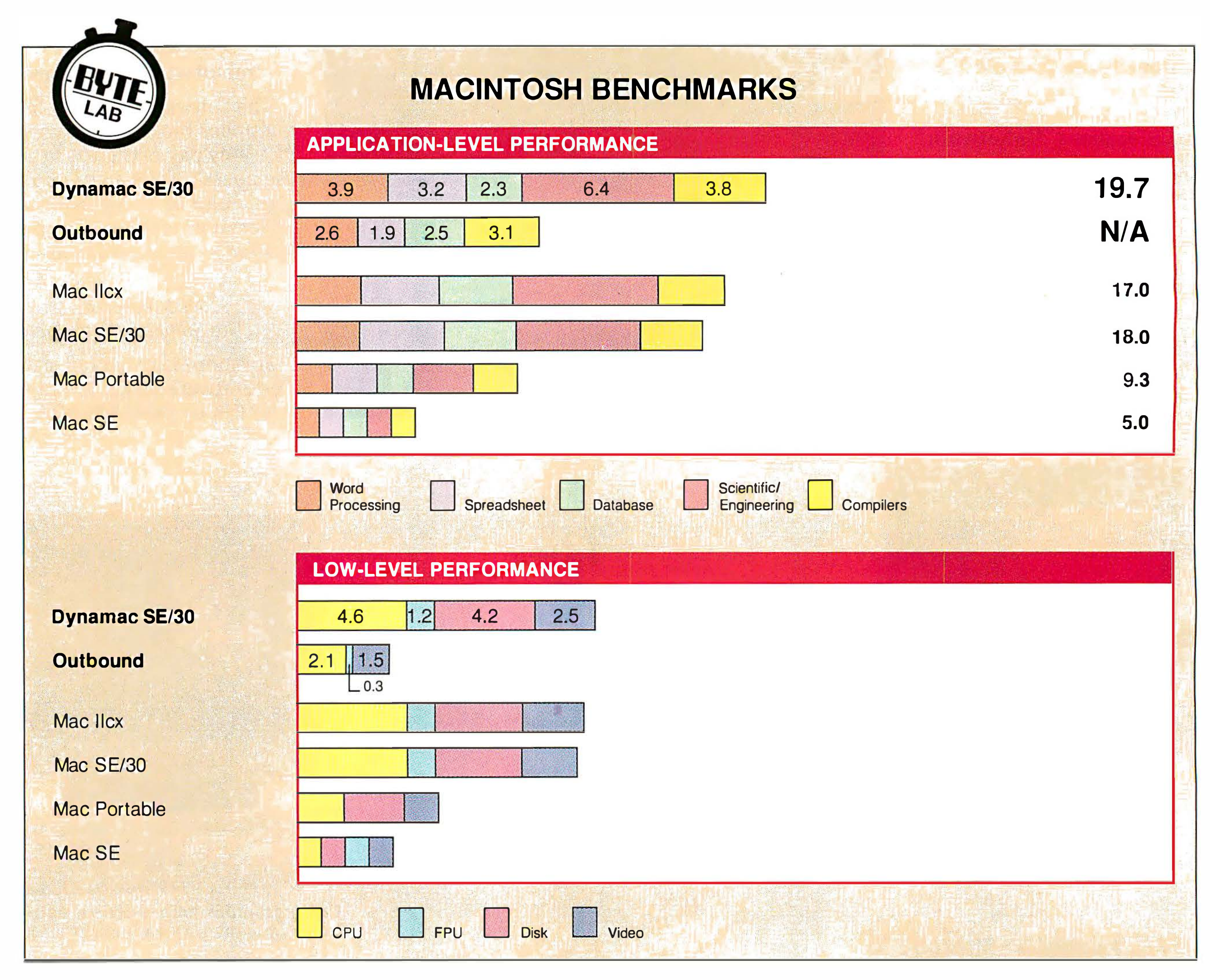
Outbound Systems uses the IsoPoint pointing device, located under the space bar, in lieu of a mouse. This is a rolling cylinder that sits inside a plastic slider that, in turn, sits inside a frame. You roll the cylinder for up-and-down pointer movement; the slider handles left-to-right motion. You press on the spring-loaded frame to perform a mouse-click. To achieve accuracy, you have to make horizontal and vertical movements separately. As a device for point-and-shoot selections on files or menu items, it works fine. For other tasks, you will be a lot happier buying the nonstandard mouse for $129.

The Outbound comes with serial and printer mini-DIN-8 ports. There's no SCSI port on the Outbound itself, but you can plug an optional SCSI adapter into the host/adapter slot. When it's docked to the Mac, the host Mac takes control. Your Mac Plus or SE can then access the Outbound's faster CPU, display, memory, and disk storage, while the Outbound's serial ports and keyboard are disabled. A special cdev lets you use either the Mac's display or the Outbound's as the main screen, or both can operate as a single screen.

When I docked the Outbound to a Mac Plus to use the Plus's external SCSI hard disk drive, the combination still booted off the Outbound's RAM disk. Since the Mac Plus has no start-up device setting, there's no way to get around this. This means that Mac Plus owners must store INITs that they use only in docked mode in the Outbound's limited silicon-disk memory. Fortunately, you can use Fifth Generation Systems' Suitcase II to bring in fonts and desk accessories that you need from the SCSI disk when the Outbound is docked.

The Outbound ran neck and neck with the Mac Portable on the CPU, FPU, and video tests, but its fast silicon disk result-

continued



CONVENTIONAL BENCHMARKS

	LINPACK (single)	Double LINPACK	Dhrystones
Dynamac SE/30	235	249	3708
Outbound	1096	2012	1744
Mac IIcx	237	250	3735
Mac SE/30	232	241	3754
Mac Portable	1154	2107	1633
Mac SE	2319	4229	805

The Outbound was unable to run the Scientific/Engineering tests. Also, the Outbound's RAM disk invalidates the low-level disk test results. The Mac Portable did not include an FPU, so it could not complete the FPU tests.

Except for the conventional benchmarks, all results are indexed; for each test, a Mac SE = 1, and higher numbers indicate faster performance. In the Dhrystone test, higher numbers indicate faster performance; in the LINPACK tests, lower numbers are better. The floating-point benchmarks use the SANE library. Comprehensive test results for all tested machines are available on request. For a full description of the Mac benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

ed in 50 percent faster performance overall on the application tests. When docked to a Mac, however, the Outbound becomes an extension of the host Mac and takes a substantial performance hit. On the Mac Plus, CPU and video performance dropped by about 50 percent. But the Outbound/Mac Plus combination still was faster than the stand-alone Mac Plus.

The Dynamac

Dynamac is no newcomer to Mac users; its original Dynamac SE appeared well before Apple's Mac Portable. The Dynamac SE/30 consists of a Mac SE/30 motherboard that Dynamac has put into a black plastic case. The orange 640- by 400-pixel gas-plasma display opens to reveal the keyboard in a typical clamshell laptop arrangement. But this is no laptop. The 18-pound system is nearly twice as heavy as the Outbound, runs only on AC power, and is far more powerful than the Mac Portable or the Outbound.

Like the Mac Portable, this is a no-compromise approach to lugging a Mac around. You don't buy this machine as an adjunct to your desktop system; it becomes your desktop system.

The basic machine includes the Mac SE/30 motherboard with a Motorola 68030 CPU and a 68882 math coprocessor, 2 MB of RAM, a 40-MB hard disk drive, and a 3½-inch 1.44-MB floppy disk drive for $9995. My test machine included a 200-MB 16-millisecond Conner Peripherals hard disk drive and 8 MB of RAM, and it carries a hefty list price

continued

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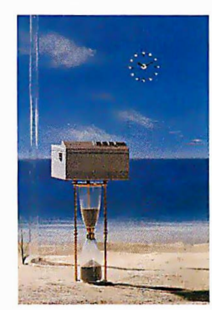
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*IID duplexing feature not supported in PostScript mode.



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of $12,995—much more than a comparably equipped Mac SE/30. Other standard items include an Apple Desktop Bus (ADB) mouse, an internal 2400-bps fax/data modem, a Sharp Wizard electronic organizer, Mindshare software, a cable for downloading information to the Wizard, and a carrying case.

At the rear of the case are the power switch, interrupt and reset buttons, a small fan, and two RJ-11 connectors for the internal modem/fax board. Also located at the rear are a SCSI port, two ADB ports, an external floppy disk drive port, two DIN-8 serial ports, and two DB-15 connectors for black-and-white and 8-bit Apple color monitors. Dynamac mounted the Apple SuperDrive floppy disk drive up front.

The gas-plasma screen has no controls for contrast or brightness, but both were fine. I found the display easy on the eyes after many hours of use. The integrated full-size keyboard doesn't detach and lacks a numeric keypad. Dynamac expects that many users will add an external keyboard and monitor.

Not surprisingly, the BYTE benchmark tests show that the Dynamac performs similarly to the Mac SE/30 on the low-level CPU, FPU, and video tests. As with the Outbound, however, faster disk test results gave the Dynamac a decisive edge over its Mac rival.

The Dynamac's inability to operate away from AC power is its main drawback. But that's not a problem for me, and the ability to have a fully functioning Mac with me at all times causes me to think kindly about the weight. But at four times the cost of the Outbound, the Dynamac's power does not come cheap. Another potential drawback is that future hardware changes (like an add-on board that uses either the Processor Direct Slot or the NuBus slot) require returning the Dynamac to the manufacturer. Dynamac promises a 24-hour turnaround on repairs, however, and its three-year warranty includes overnight shipping both ways.

One for the Road

How much of a compromise you make on the road will be the key to what hardware you should choose. If you can do without the Mac environment on the road, relatively inexpensive PC-compatible laptops offer equivalent or better computing power in a smaller, lighter package.

I demand processing power beyond issues of weight, so although the Dynamac SE/30 weighs nearly as much as a Mac SE/30, it has the processing power I need. The Mac Portable, by contrast, is nearly as heavy, costs nearly as much, and uses the wimpy 68000 CPU. What you don't get are the Mac Portable's sharp active-matrix LCD and battery-powered operation (for a review of the Mac Portable, see "Hit the Road, Mac," February BYTE).

If you already have a Mac Plus or SE, the Outbound Laptop System greatly extends the usability of your existing hardware at a much lower cost than the Dynamac or the Mac Portable. Battery life is less than half that of a Mac Portable, and the display isn't as sharp, but the Outbound weighs substantially less, fits into a smaller space (crucial in airline cabin luggage compartments), and costs far less than Apple's $4799 starting price for the Mac Portable. ■

Laurence H. Loeb is a BYTE consulting editor and is editor of the BIX Macintosh Exchange. You can reach him on BIX as "lloeb."

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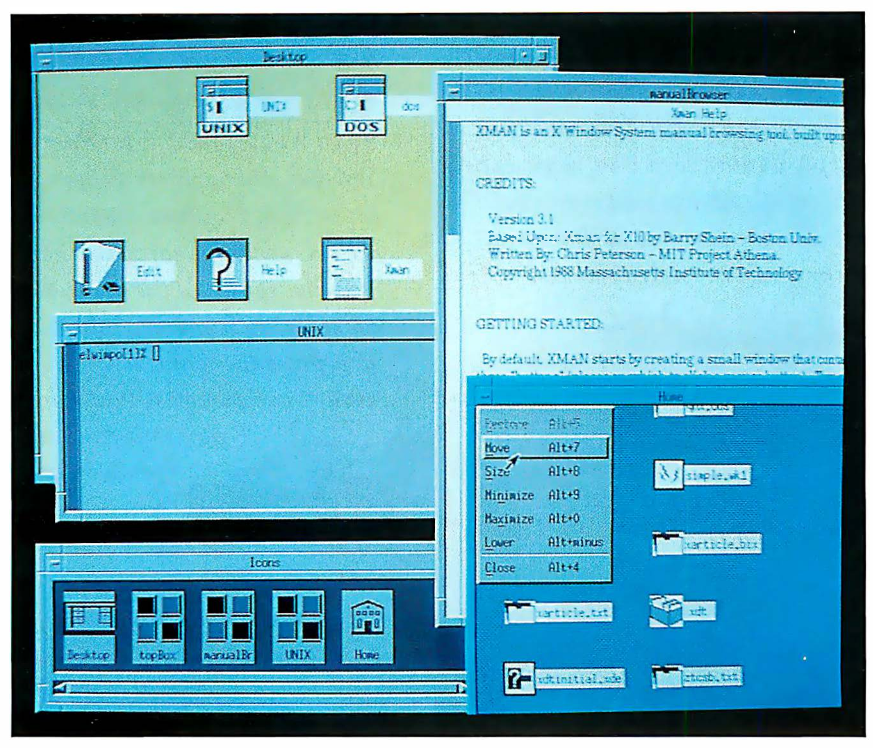
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Circle 201 on Reader Service Card

Tom Yager

REVIEW

Open Desktop: Relief for the Unix-Wary



Open Desktop, as its name implies, uses a desktop metaphor to make Unix friendlier.

Unix may be the best-suited operating system for today's computers, but ironically, many believe it's still unsuitable for business use. Why? The leading complaint is that it's "unfriendly." If only someone could simplify Unix, make it as easy to use as DOS, or, better still, a Macintosh. Well, perhaps someone has.

Enter The Santa Cruz Operation, better known as SCO, with Open Desktop. Open Desktop seeks to do for Unix what DOS did for a PC—make it accessible to everyone. For just under $1000, Open Desktop is truly everything you need to get Unix on your 386- or i486-based PC. It includes the SCO Unix System V operating system, Locus's XSight X Window System graphical user interface, IXI's X.Desktop graphical environment, Locus's Merge/386, Lachman Associates' TCP/IP and NFS, and the Ingres relational database manager. All this is crammed into a deceptively tiny box, and the documentation amounts to two tightly packed paperbound books. However, SCO spreads the software across a whopping 43 5¼-inch floppy disks.

Breaking the Seal

I tested Open Desktop on a pair of systems. The first was a Dell System 325 (25-MHz 386) with 8 megabytes of memory and a 150-MB ESDI hard disk drive—my low-end machine, and probably typical of an individual Open Desktop user machine. The other system was an Altos System 5000 Power Server with a 25-MHz i486, 32 MB of memory, and an 840-MB SCSI hard disk drive; it was loaded with Altos's OEM server version of Open Desktop, and it is representative of the most capable platform for the software.

SCO's installation procedure is among the most manageable I've used, with one exception. After all the software is installed, an initialization script is executed for each selected subset. If something goes wrong during this process, you can't just rerun the scripts by hand; you've got to reload the disks.

When you're asked whether you want "C2 trusted security" or "relaxed defaults," consider your answer carefully. If you select the trusted option, your system will be transformed into a fortress, impervious to snoopers, hackers, and system administrators alike. Don't choose C2 security just to play with it. Even though SCO reduced the administration of security to a bunch of menus and forms, it's a big bunch. Unless you're working for the government or like to pretend you are, don't bother with C2.

The Fruits of Your Labor

Neatly separated into user's and system administrator's guides, the Open Desktop manuals are a study in minimalism. How did they get so small? Simple. SCO left out the reference manuals. You'll find no alphabetized list of commands in either volume. Instead, you are directed to browse the on-line manual pages and help facilities. Unix old-timers are used to asking computers for documentation, and newcomers will adapt quickly as well. It's a mighty convenient way to look things up.

I'll admit that SCO's new manuals took a bit of getting used to. They are both split into sections, covering the major components of Open Desktop. Each section covers only what SCO considers the important points, and the reader is sometimes directed to purchase optional documentation to fill in the rest. Except for the missing pieces, however, I thought SCO's documentation was well done. As it stands, I can pick up one of the books and zip immediately to the section that covers my topic of choice. It might instruct me to go out and buy additional manuals, but at least I know where to look.

Two parts of the manuals left me disappointed: The administrator's section on the SCO Unix mail program (MMDF) and the section on the database manager. There is no such thing as an easy Unix mailer, but MMDF still gets my prize for the most convoluted, most poorly conceived of the lot. At least for now, SCO has added a more common mailer, `sendmail`, but the documentation warns that it is unsupported and admonishes the user that it should be used only if unavoidable. The manual's description of the maze of configuration files needed to set up MMDF is so poor that even an MMDF expert would be left wondering which end is up. The only respite is a set of step-by-step instructions for configuring a typical system. If your system is

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Open Desktop 1.0.0

Company
The Santa Cruz Operation, Inc.
400 Encinal St.
Santa Cruz, CA 95061
(800) 726-8649

Hardware Needed
Intel 386 or i486-based PC with 6 MB of memory (8 MB is recommended) and up to 100 MB available on disk; mouse and graphics display required for X Window System operation

Price
$995

Inquiry 883.

close enough to this example, you may survive. I didn't. The forbidden `sendmail`'s standard configuration handles my setup perfectly, but I never did get MMDF to sit still for it.

As for the Ingres database, that offering is long on software and far too short on documentation. Running it for a few minutes left me feeling that it could do *anything*, but the documentation drops off just where things start getting interesting. Without reference pages, the powerful Structured Query Language and command interfaces are useless. I can understand SCO's motivation to keep the documentation set petite, but I wonder how many Open Desktop users will never bother to unlock the real power of Ingres. A thorough reading of the manuals would leave you thinking that Ingres is a $99 toy filing program, instead of one of the most powerful DBMSes extant. Ingres, in large part, gives Open Desktop its style and its serious, professional flavor. I can't think of anyone who couldn't profit from its use.

The Grand Tour

You might figure that, with 43 disks, there must be some substance to Open Desktop. There's plenty. A good place to start is with the fabled desktop itself. The graphics are served up by Locus, which provided SCO with a capable port of MIT's X Window System. The OSF/Motif window manager (`mwm`) runs the window show, but atop it all sits X.Desktop.

X.Desktop is one of a few products that gives Unix a shot at being called friendly. The shallow view is that it provides a point-and-click interface to Unix, comparable to that of the Macintosh. Files become icons, and these icons interact predictably. Drag a file into the Trashcan, and it is deleted. Drag a file into a folder icon (which represents a directory), and the file is moved there. You can rename files, check and change permissions, and launch applications without ever going near a Unix shell prompt.

This desktop manager is completely driven by a set of text files, each scripting the actions taken when you manipulate icons. IXI built a complex programming language into X.Desktop that makes it completely configurable. If you don't like the way the Trashcan icon acts, you can substitute your own behavior script. Entire kingdoms of icons can be added, and administrators can calm even the most timid user by adding new commands to the system in this way.

As mentioned, Ingres is an impressive database manager. Run from the Open Desktop command line and a full text-only screen (no XSight), Ingres's interface serves its purpose. Menus behave intuitively, and the program is easy to navigate once you get the hang of it.

The dark side of Ingres's interface is called WindowView. I have only one word for it—horrid. The premise is this: You can take a good text-based application, paste some simple mouse sensitivity into it, and have a good X application. If the premise sounds flaky, its implementation is worse. So, you see a menu, and you click the mouse button on an item to make it happen, right? Wrong. You click on the item and then click on the keyword Go in the bottom line of the window. Worse, you lose the ability to use the keyboard with the menus. A single click works on the horizontal menus across the bottom of the window (where the magic Go appears), and this menu includes everything in the fancy (useless) boxed menu. Two or three pixels below lies the window-resize bar, and you'd better get used to pressing that by accident. But don't judge Ingres by its half-baked, pseudographical interface. It's a beefy database manager that just needs the screen to itself.

The overall quality of Ingres comes with a price: It is memory- and disk-hungry. Even when you're only running your own private databases on your isolated system, Ingres behaves as a client/server application. It takes several daemons (background processes) just to support one Ingres session, and some of these background programs span nearly 2 MB. Running Ingres on the Dell System with 8 MB of memory caused the system to go swap-happy. Nothing failed, and the slowed performance was still acceptable, but the disk went wild while the operating system scrambled to stoke Ingres's furnace with more memory. (The Altos, with 32 MB, ran without swapping.) According to SCO, a special package, the Open Desktop Server Upgrade, will let you set up a centralized Ingres database server, bringing down the memory and disk requirements at each desk. However, the upgrade was not shipping at the time of this review.

Getting Down to DOS

If you double-click on the DOS icon, a Merge/386 window appears, containing a C> prompt that makes a DOS user feel right at home. To simulate a color DOS display, Merge takes over all the colors (16 in the case of VGA), resulting in a strange color shift when the DOS window is selected. This is normal and even desirable. I was able to install many applications that use color text and have them behave predictably in the DOS window. The window is also capable of displaying CGA graphics, an interesting feat considering that memory-mapped graphics have to be converted to X instructions. CGA graphics works well, and an application can talk to the window as though it were a CGA display. It also supports 40-column text, 640- by 200-pixel graphics, and all the other CGA modes. When you change modes, the window changes size automatically to match the screen size of the mode.

Merge runs under the virtual 8086 built into the 386 and i486, so you can't run protected-mode programs or anything written specifically for the newer Intel processors. This is something of a handicap, since there is a lot of software now that just assumes you've got at least a 286. Still, Merge had to work with what Intel gave it, and it does work. For the mainstream DOS productivity applications, it performs admirably. A single session on the Dell System runs at roughly the same speed as that of an IBM AT. The Altos performed much better, of course.

For those times when your native display is the only way to go, you can ask Merge to turn over the entire screen to DOS. A hot-key sequence brings up a menu, and clicking on Zoom makes the switch—in my case, to VGA. I was able to run everything that talks to real VGA with reasonable performance.

Could you run Merge all the time? Absolutely. I found it provided faithful emulation and excellent stability. A fringe benefit is that, since Merge runs as a client of Unix, you can run DOS programs that crash. In most cases, Merge just resets itself, and you're back in business.

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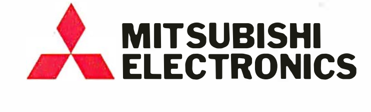
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In no case have I seen it crash Unix or otherwise affect other processes.

Ordinarily, Merge uses the Unix file system to store application data. To a DOS program, Unix files are made to look like DOS files. Filenames that don't fit the eight-plus-three DOS naming conventions are squashed in a nonintuitive way. There was no right way to handle this problem, so any solution that simply makes the files available is passable. You can also use the real DOS partition on your hard disk drive. Another plus is that you can map Unix networked disk drives into Merge's DOS as well.

Stringing the Nets

Open Desktop includes a boatload of networking solutions: TCP/IP (the Unix standard), Sun's NFS, and Microsoft's LAN Manager. The LAN Manager module operates as a client only, and while SCO will sell the server portion, I recommend sticking with NFS.

Getting your new workstation attached to an existing Unix network isn't automatic, but it's pretty easy. I dropped a Western Digital Ethernet adapter into the Dell System and told Open Desktop about it during the installation. You'll be asked for the network address of your system, but you won't be able to see other systems until you add them to your `/etc/hosts` file.

As part of a Unix network, an Open Desktop system is mostly a good citizen. In the BYTE Lab, the Dell System was asked to swap files with our Unix server (a Swan 386/33 running Interactive's 386/ix 2.0.2) and an Opus Personal Mainframe (a 25-MHz 88000-based system). My first attempt to copy files through NFS to the 386/ix system crashed it and jumbled its hard disk—everything was lost. The problem was Interactive's, and installing its latest release (version 2.2) fixed everything. The Opus got along famously from the start with Open Desktop, except that it complained periodically about a protocol screwup when I used `rcp` (remote copy). In my home lab, where the Altos resides, I've encountered absolutely no problems shipping data, X images, and shared files across the network. Altos did a bit of work on Open Desktop's networking facilities, and it seems to show.

An Open Closing Statement

Open Desktop wants to be the shrink-wrapped Unix for the 1990s. It is packaged to run on just about any 386 or i486-based system and truly can be pulled off a shelf and run out of the box. SCO's price, $995, is very attractive considering all that's thrown in.

Open Desktop is the only Unix system I can truly recommend to new Unix users. You might need some experienced help during the first couple of days, but once you've gotten that push, you'll be hooked. Also, SCO's technical-support department is responsive—every call I placed got me a prompt and accurate answer.

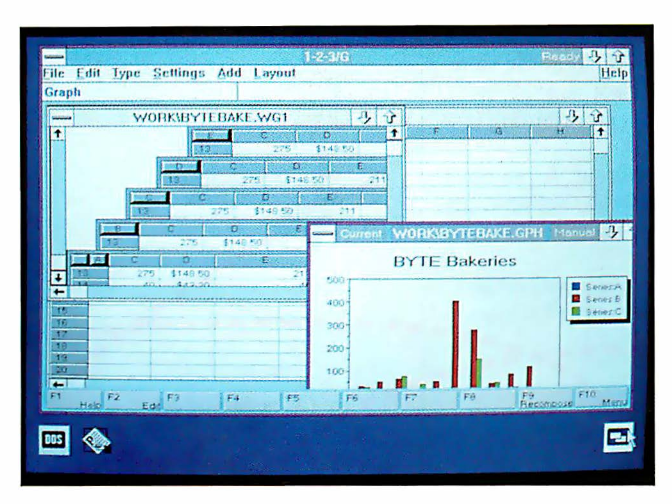
SCO's coup is that it has built a Unix system you can use without taking the time to understand it in depth. Thirty minutes after installing it, you can run your favorite DOS applications in an X window under Unix. You can progress from there to learning about Unix, Ingres, X.Desktop, and the rest. But the real work can come first; there will be plenty of time to explore. ■

Tom Yager is a technical editor for the BYTE Lab. He can be reached on BIX as "tyager."

Stanford Diehl

REVIEW

G Is for Graphics



With the PM windowed interface, you can keep a number of worksheets on the desktop. Note the three-dimensional structure and the third scroll bar for scrolling across pages. The graph in the window displays spreadsheet changes interactively.

Why in the world would we need another Lotus 1-2-3 for OS/2? Lotus already offers 1-2-3 release 3.0 for OS/2, but now there's 1-2-3/G as well. As with release 3.0, much of 1-2-3/G's impressive power stems from the underlying features of OS/2, but its real draw is its graphical interface. If you buy into the GUI revolution, Lotus finally has something for you.

Of course, a graphical interface delivers more than just a pretty face. Some of the spreadsheet's features are more readily tapped and are more powerful using a mouse. Although release 3.0 works like a champ under OS/2, it still uses the old character-based interface, which fits awkwardly in the Presentation Manager environment. Lotus 1-2-3/G gives you the same windowed environment of PM while retaining keystroke compatibility with the original 1-2-3.



Lotus 1-2-3/G

Company
Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500

Hardware Needed
IBM AT or compatible (386-based PCs recommended); 4 MB of RAM; hard disk drive

Software Needed
OS/2 1.1 or higher

Price
$695

Inquiry 887.

The Graphical Advantage

The 1-2-3/G graphical interface is inviting and responsive. I'm not completely sold on the advantages of using a mouse for spreadsheet work, but mouse or no mouse, you can't help but appreciate having multiple windows on the desktop. Moving data or linking data from one sheet to another is much easier when you can view and access both sheets at the same time. You simply open a file in its own window. You can then resize it, minimize it, cut and paste to other windows, and interact naturally with other PM applications on the desktop.

The page-preview features of 1-2-3/G, while nice to have, are awkward and inflexible. So, I fired up PageMaker OS/2 in its own window and pasted 1-2-3/G's spreadsheets and graphs into PageMaker. I could then place the spreadsheet elements anywhere on the page by simply clicking and dragging, printing the document, minimizing PageMaker, and returning to my spreadsheet work. When I needed PageMaker again, it waited a click away. Once you've got your windows effectively placed, you can save the whole bundle in a single desktop file.

The PM interface also provides Dynamic Data Exchange, which lets you link your spreadsheet data to other PM applications. For example, you could paste a spreadsheet to a word processor and link it so that whenever you change the spreadsheet numbers, the word processor document is automatically updated. Unfortunately, the potential of DDE—like that of OS/2, in general—suffers from a lack of OS/2 applications.

Of course, 1-2-3/G also boasts true three-dimensional operation, but, ironically, that very capability makes its graphical perks less useful. True 3-D places all your related worksheets in a single structure. You could, for example, put each of your monthly sheets on separate pages of your 3-D spreadsheet. Your annual totals could also reside within the single structure. The monthly totals could be summed by referencing them as a range cutting through the 12 pages. Under this scheme, autonomous windows are not such a big win.

Then again, the program makes moving around in a 3-D spreadsheet easier by adding a third scroll bar. In addition to the scroll bars that let you move down rows or over columns, the third scroll bar moves you through multiple pages. I found this useful only when I had to flip through a lot of pages. Otherwise, I turned a page by pressing Alt-PageUp or Alt-PageDown.

Predictably, the graphing tool improves under a graphical interface. The graph comes up in its own window and menu bar. You can move objects, such as the title or a legend, by clicking and dragging them. You can also add markers or annotations and move them about just as easily. By strategically overlapping your graph window and spreadsheet window, you can see how changes to your data affect your graph. There's a full range of graph types available, and 1-2-3/G can map your color bars or pie slices to black-and-white patterns. So you can keep your on-screen graphs as solid colors and print them as monochrome patterns without reconfiguring graph options.

The Performance Trade-Off

Release 3.0 wins hands down when it comes to questions of performance (see the figure). Using our standard spreadsheet benchmarks (for details, see "Not Just for Numbers Anymore," February BYTE), release 3.0 again showed its exceptional speed. This performance advantage becomes significant when spreadsheets become big and complex.

I also ran into some disturbing problems with 1-2-3/G, mostly related to the Undo feature. When I was working with large files and would load a spreadsheet into a window and then try to retrieve a different spreadsheet into the active window (an operation that should throw the first spreadsheet away), I hit the dreaded

continued



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  — *EVOLUTION COMPUTING*
- "SilverScreen will benefit greatly from the coprocessor's ability to move matrix transformation onto the chip itself," says Jeff Howe, Schroff Manager of R&D. "We did not have to change any of SilverScreen's code to be able to run with any of the IIT math coprocessors. With the implementation of the 4X4 instruction set by the IIT products, SilverScreen now offers the user the ultimate in 3-D performance! Workstation functionality is now available at the DOS level."
  — *SCHROFF DEVELOPMENT*

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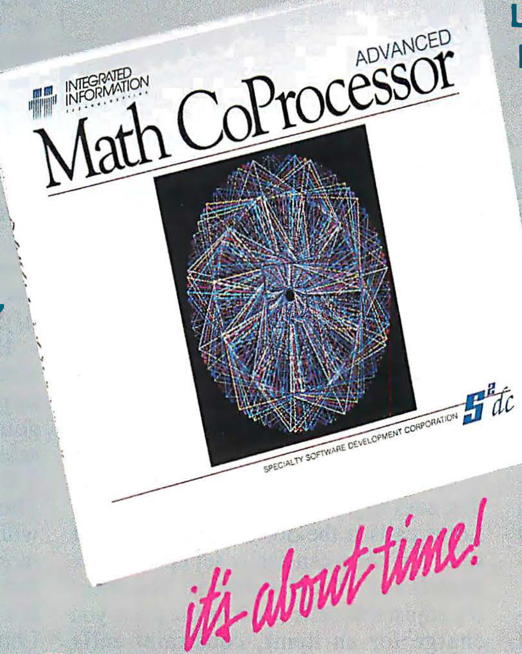
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Circle 270 on Reader Service Card

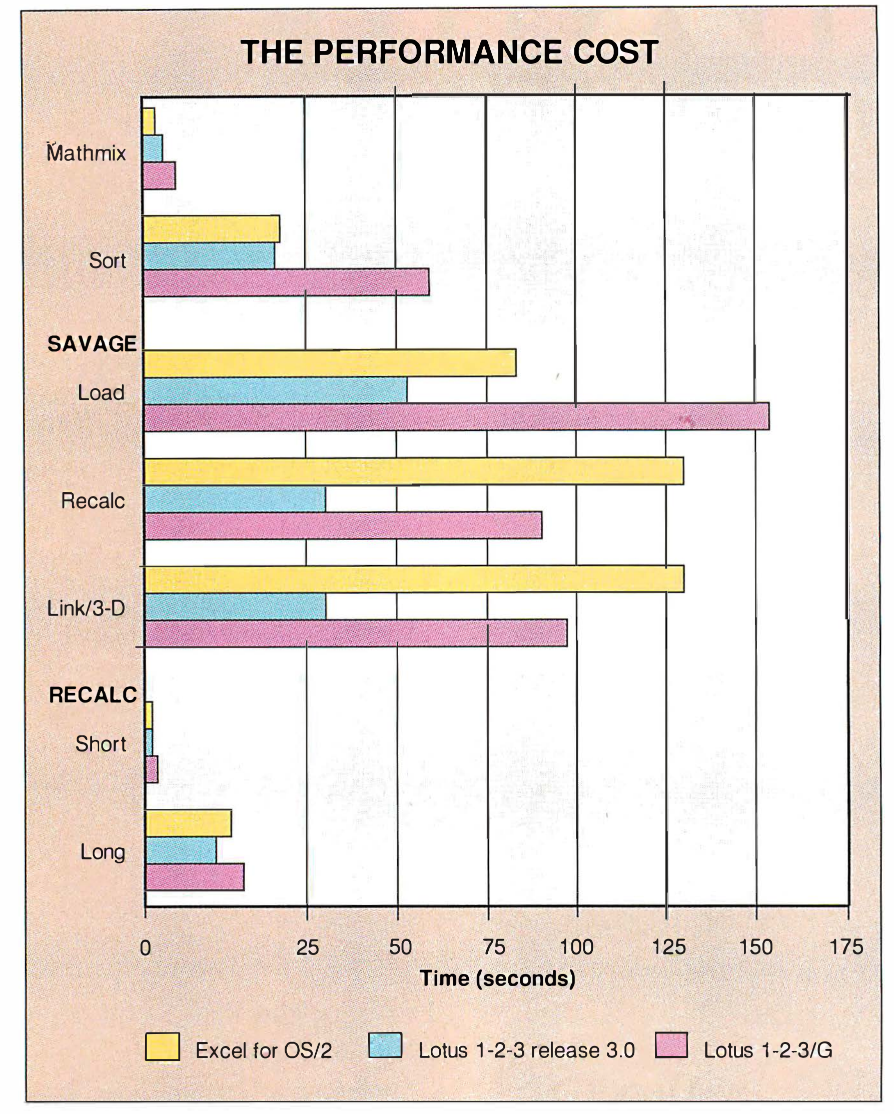


Figure 1: *Lotus 1-2-3/G pays a performance penalty for its graphical interface, as it is significantly slower than its sibling, 1-2-3 release 3.0. Shorter bars indicate better performance. (For a complete explanation of the spreadsheet benchmarks, see "Not Just for Numbers Anymore," February BYTE.)*

memory barrier. It was disconcerting, given that I was working on a Compaq 386/20 with 6 megabytes of real memory and another 4 MB of swap space on disk.

The memory problems did not occur under release 3.0, nor did they occur with the Undo feature disabled. The trouble, then, was obvious: 1-2-3/G was retaining the discarded spreadsheet file in memory so the Undo option could get it back. That's understandable, even desirable, and easily disabled.

You can blame it, though, for not handling memory limitations gracefully. I got a message that Undo was being disabled, closely followed by a memory warning. I clicked the OK button, at which point the program sometimes froze. I could still access the Task Manager and shut down 1-2-3/G, but by killing the task, I would lose other files on the desktop. At other times, 1-2-3/G would load an empty worksheet with the same filename as the worksheet it failed to retrieve.

There is one big advantage for 1-2-3/G that goes beyond the graphical interface. Lotus calls it the Solver, and that's just what it is. You can easily set up complex models and what-if scenarios. You specify adjustable cells (such as the price you charge for an item), constraint cells (such as the number of items in your inventory), and a cell to maximize (such as profits). The Solver then returns many solutions for the defined problem.

For testing purposes, I set up BYTE Bakeries as a model. The worksheet listed a variety of pastries and, for each pastry, reported the cost to make them, the selling price, and the number made. I selected the number-made entry for each pastry (the adjustable cells) and entered a series of simple logical formulas that set maximum and minimum values for each of the number-made entries (the constraint cells). I was also constrained by the total cost of all pastries, representing the limit of my current resources. I then asked Solver to optimize the profits entry. Solver returned several possible solutions so I could decide which mix of pastries would maximize my profits.

In the same way, you could pick the optimal mix of stock investments for a portfolio. The Solver surpasses the simple what-if capabilities of most spreadsheets. If you do a lot of spreadsheet modeling and what-if calculations, the Solver alone could justify the switch to 1-2-3/G.

Finding the Right Fit

It sounds strange to call a Lotus spreadsheet a niche product, but 1-2-3/G may fill the bill. I would recommend it for specific situations. If you have dedicated Lotus users along with users just learning spreadsheets, 1-2-3/G offers a middle ground. The old users can still employ the slash key, while new users should feel less intimated by the point-and-click interface. In fact, if you're sold on the PM interface, 1-2-3/G could be the perfect vehicle for weaning your 1-2-3 junkies off the keyboard and onto the mouse.

Users who include their spreadsheets in other applications will also benefit with 1-2-3/G. Pasting to PageMaker or linking to a database is smoother under the graphical interface. Finally, users who have modeling chores that require the sophistication of the Solver can justify the 1-2-3/G investment.

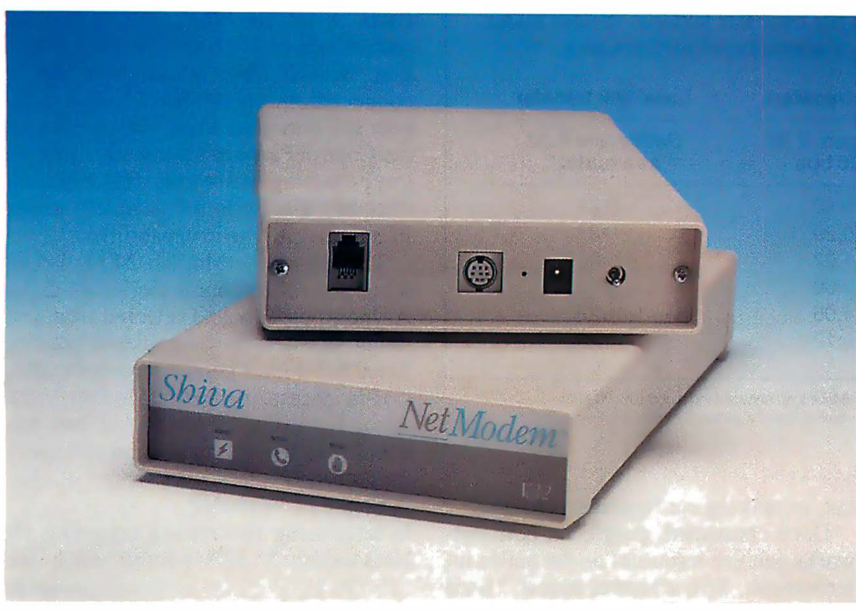
However, if you're a single user who is already productive with the old Lotus interface, there's not much incentive for going to a graphical interface just for the sake of having one. You'll find release 3.0 less frustrating and more stable. Those who spend the bulk of their day within the Lotus environment will be more productive under release 3.0. In fact, that is 1-2-3/G's biggest drawback: It's hard to upstage a program as good as Lotus 1-2-3 release 3.0. ■

Stanford Diehl is a testing editor/engineer for the BYTE Lab. He can be reached on BIX as "sdiehl."

Christopher R. Gibson

REVIEW

9600-bps Modem Brings Apple Networks Closer Together



Shiva's NetModem V.32 offers 9600-bps communications as a shared network device or as an internetwork router, thanks to its built-in AppleTalk connector (top).

Advances in LAN technology have made shared computer resources a fact of life in many companies. Shiva promises similar rewards for far-flung Apple networks with its NetModem V.32, which places wide-area-network (WAN) technology into the hands of small businesses. Thanks to a built-in AppleTalk connector, the NetModem V.32 can connect AppleTalk networks or allow traveling employees full dial-in access to company Macs and peripherals. It also offers a major performance improvement over its predecessor, the NetModem 2400.

The NetModem V.32's foundation is a 9600-bps V.32 modem. The V.32 protocol allows the modem to communicate dependably with other V.32 modems at full speed over ordinary phone lines. But once you pull the new NetModem out of its box, you'll see that it is not an ordinary modem. In back, it offers three connectors: phone, power, and AppleTalk.

The significance of the AppleTalk connector may not be immediately apparent, but it is the key to the NetModem V.32's power. It enables the NetModem to take advantage of the AppleTalk networking protocols included in every Mac. Thus, the device can become a shared modem available to every Mac on a network, and it can serve as a remote router (or half-bridge). As a router, it can connect two remote AppleTalk networks to form one internetwork, allowing each node to transparently share all the resources of both remote networks, whether they are 1 mile or 1000 miles away.



NetModem V.32

Company
Shiva Corp.
155 Second St.
Cambridge, MA 02141
(617) 864-8500

Hardware Needed
Macintosh-family computers or related peripherals attached to a LocalTalk network; LocalTalk connectors and cabling; a dedicated phone line (when used as an internetwork router)

Price
$1999 each (two are required for internetwork routing)

Inquiry 855.

Just Add AppleTalk

Installing the NetModem is as easy as adding any other device to an AppleTalk network. Each Mac that will use the NetModem to dial out needs the NetModem software installed on its start-up disk.

Shiva's Internet Manager application examines, sets up, manages, and performs troubleshooting on AppleTalk internetworks. I found it to be handy when configuring the NetModem. You can also use it for Shiva's innovative method of updating NetModem V.32 firmware: Instead of requiring you to replace ROM chips, the NetModem V.32 can simply download an image file from disk into its battery-backed-up RAM.

In general, using the NetModem V.32 as a dial-out modem is identical to using its slower cousin, the NetModem 2400. Through the standard Chooser desk accessory (DA), you can select any NetModem connected to the network. If the NetModem is busy, the software records your request; it then notifies you when the device becomes available. If you have several NetModems on your network, you can even select a pool of NetModems, so that if one is busy, another in your pool can be used.

Once a NetModem has been selected and the connection to your Mac is established, using the NetModem V.32 is much like using any high-speed modem. It uses the standard Hayes AT command set and responds in much the same way as a dedicated modem. A small display appears in the menu bar and mimics the display lights normally found on the front of a modem. Even the sounds from the modem are transmitted over the network to your internal speaker.

Remote-Routing Power

But the NetModem V.32's real power lies in its remote-routing capabilities in an internetwork. For this, you need two remote AppleTalk networks, each with a NetModem V.32 (or one with a NetModem V.32 and one with a Shiva TeleBridge or EtherGate). To create the internetwork, a user in one network initiates the call; the NetModem in the other remote network answers and automatically forms the connection.

The software that controls the initiation of the connection is accessed through a standard Control Panel DA. A Dial Out window lets you set up miniature scripts for the various remote networks you will be calling. These scripts include phone numbers, connect speeds, and access limitations.

The Internet Manager application con-

continued

TRANSFER TIMES

The NetModem V.32 outshined the baseline 2400-bps modem in direct transfers. More significantly, the NetModem's times as a 9600-bps router for LocalTalk transfers were close to those for direct transfers. At 9600 bps, the NetModem averaged one transmission error per 70K bytes transferred. Dial-in access gave comparable times. Creating moderate to heavy intranetwork traffic during testing, in the form of large file transfers between various nodes on one network, did not significantly affect internetwork performance.

	Direct modem-to-modem transfers		LocalTalk transfer
File size (bytes)	**2400-bps modem**	**NetModem V.32, 9600 bps**	**NetModem V.32 as a router***
10K	0:44	0:12	0:21
25K	1:48	0:29	0:37
50K	3:35	1:02	1:08
100K	7:10	2:08	2:12
200K	N/A	4:05	4:29
500K	N/A	10:12	10:16

* Routing benchmarks measure transfers between a simple four-Macintosh network and a complex 20-Macintosh network connected through remote routing. Transfers in both directions yielded comparable times.
All transfers were made using ZMODEM and MacBinary II.
Times are in minutes:seconds. N/A = Not applicable.

figures the NetModem V.32 to limit access to particular AppleTalk zones (if your network has them) and specifies separate passwords for dialing in, dialing out, or making configuration changes.

Once connected, people on both networks can use resources on the entire internetwork. To test remote access, I used NetModem V.32s to connect my AppleTalk network in California to a friend's AppleTalk network in Tennessee. We accessed each other's file servers and printers and sent E-mail transparently.

Dial-in access is the single-user equivalent of remote routing, with two differences. First, the Mac initiating the call can use any modem to make the connection. Second, only single users can be connected, not networks. The dial-in access software that Shiva ships works via the Control Panel as seamlessly as the remote-routing software. For $99, the company also sells software that allows PCs the same dial-in capabilities.

The slower NetModem 2400 also offered this ability, but it used a DA called Async AppleTalk and suffered from irritating slowness and occasional crashes. Shiva has done a good job reengineering dial-in access in the NetModem V.32. Also, I think a speedier 9600-bps modem is much more suitable for this use.

A Sense of WANder

In tests using two remote networks, the NetModem V.32's performance was

continued

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excellent. Direct modem-to-modem transfers as a shared network modem ran as efficiently as those of a dedicated modem (see the table). Occasional transmission errors at 9600 bps indicate these speeds push the limits of ordinary phone lines, but the V.32 protocol did a good job at maintaining the connection's integrity.

In remote-routing applications, the NetModem V.32 proved itself a reliable performer in networking environments ranging from my relatively simple Macintosh development network of TOPS file servers and E-mail, to a complex network at a local graphic arts company, consisting of two AppleShare file servers, 20 Macintoshes, Apple LaserWriters, and a Linotronic L300 ImageSetter.

The NetModem V.32 had an overall "feel" that was excellent across the board. There were short delays while choosing printers or file servers from the Chooser, for instance, but nothing troublesome. And although file transfers were slower than with a direct connection to an AppleTalk network, printing operations were surprisingly quick, adding only about 20 seconds to the 1½ minutes it took to print a sample five-page text document or a MacDraw graphic.

However, there were some problems when communicating with on-line services such as BIX. The NetModem V.32 tended to lose control at random times. The resulting garbage could only be terminated by cycling the power on the NetModem. Shiva is aware of this problem (cycling the power is the company's workaround), and it expects to release a fix in the form of a new image file soon.

The Shiva technical-support people took a thorough report of the garbage bug and promised to pass it on to the engineers, but I did not hear back from them until I contacted Shiva and identified myself as a reviewer. This is a shame, because my previous experience with Shiva's support has been generally positive.

Even at $1999 each, the Shiva NetModem V.32 gives you a sense of awe at how well it works. Internetworking between remote users or AppleTalk networks is easy to establish and easy to get used to. Combining those features with the ability to share a high-speed modem among many users makes this an attractive investment for businesses in search of the advantages of WAN technology. ■

Christopher R. Gibson is president of Cloud Ten, a Macintosh development firm located in San Luis Obispo, California, and is a moderator of the BIX Macintosh Exchange. He can be reached on BIX as "cgibson."

Stan Miastkowski

REVIEW

New Floppy Drive Puts 20-MB Disk in Your Pocket



The Stor/Mor Subsystem uses a SCSI controller to bring 20-MB floppy disk storage capacity to PCs and PS/2s.

BYTE LAB

Stor/Mor Subsystem

Company
Q/Cor
One Meca Way
Norcross, GA 30093
(404) 923-6666

Hardware Needed
IBM XT, AT, PS/2, or compatible

Price
External version as tested: $895
Internal version: $795
Micro Channel architecture subsystem: $995

Inquiry 882.

While some computer technologies forge ahead at breakneck speeds, floppy disk drive storage usually progresses at a leisurely pace. Capacities grew from 180K bytes to 1.44 megabytes only in incremental jumps. Now they are beginning to leapfrog, thanks to the 20-MB floppy disk drives hitting the market.

I tested one of the first: Q/Cor's Stor/Mor drive, which uses 3½-inch floppy disks that only look like the standard disks. Based on the Flextra system developed by Brier Technology (San Jose, CA), the Stor/Mor drive uses Twin Tier Tracking (T^3) technology (see the figure).

As the name implies, two layers of magnetic material reside on special floppy disks that cost a hefty $25 each. The entire upper layer is free for data storage. The lower layer, which is permanently formatted at the factory, contains positioning (servo) information for the read/write heads. This low-frequency magnetic homing signal sends a continuous message to the read/write head. The embedded positioning information enables the head to track more tightly and accurately than in traditional floppy disk drives. This allows for a density of 777 tracks per inch, versus about 135 tracks in traditional floppy disk drives. In addition, most drives store data uniformly throughout the disk surface. But the Stor/Mor takes advantage of the longer sectors near the disk's outer edge by packing more data there than is possible in the shorter, inner sectors.

The Stor/Mor comes in both an internal version that fits in a standard 3½-inch floppy disk drive space and an external version. It uses a SCSI controller and is available with both AT and Micro Channel SCSI controller boards.

Installation Woes

Getting the external version of the Stor/Mor to work in my AT clone wasn't a "plug and play" proposition. The SCSI host-adapter board requires you to set address and interrupt-level jumpers. Because my system already has other boards in place, I had to do some fiddling to get everything right.

I then had to install a device driver in my CONFIG.SYS file and reboot. Problem solved? Not quite. My system, which has a 64-MB hard disk drive partitioned into logical drives C and D, wouldn't recognize the Stor/Mor. Eventually, I realized that the second physical hard disk drive (the Stor/Mor) became drive D. But I still kept getting an "I/O error" message on my screen.

I ended up spending several hours fooling with my CONFIG.SYS and AUTOEXEC.BAT files, painstakingly removing individual TSR programs and device drivers. The culprit turned out to be a disk-caching utility, which somehow clashed with the Stor/Mor driver. Once I removed the utility, I was able to boot from the Stor/Mor drive.

After an extensive talk with the Q/Cor people, they admitted that they have to revise the driver for the Stor/Mor to avoid these conflicts.

continued

Another page in printer history.

BUBBLE JET PRINTER BJ-10e

BUBBLE JET

Introducing the first printer that is both a desktop and a portable and prints with letter-quality precision on plain paper: The Canon BJ-10e Bubble Jet.™

On a desk, with its optional 30-sheet paper feeder, it's an ideal personal printer. As a single-sheet portable with its optional rechargeable battery pack, it weighs a remarkable 4.6 pounds and prints on a variety of paper. Moreover, the BJ-10e emulates the IBM® Proprinter™ X24E, so you can use a wide range of applications software.

How fast is it? It prints 83 characters per second and won't slow down when printing in bold or various type sizes. It even handles complicated graphics such as the scanned-in image printed here. And, it's so quiet it can be used in the middle of the night with someone asleep just a few feet away.

Plus you never have to worry about maintenance because it uses an economical pop-in BJ cartridge, containing the print head and ink supply, which prints approximately 700,000 characters (HQ mode). But best of all, the BJ-10e works everywhere you could possibly need it, fitting neatly into a briefcase.

The BJ-10e Bubble Jet. What other printers print on a desk, it prints anywhere.

The document displayed in the BJ-10e is actual output using the UltraScript™ pc software BJ-130e™ printer driver.



Canon

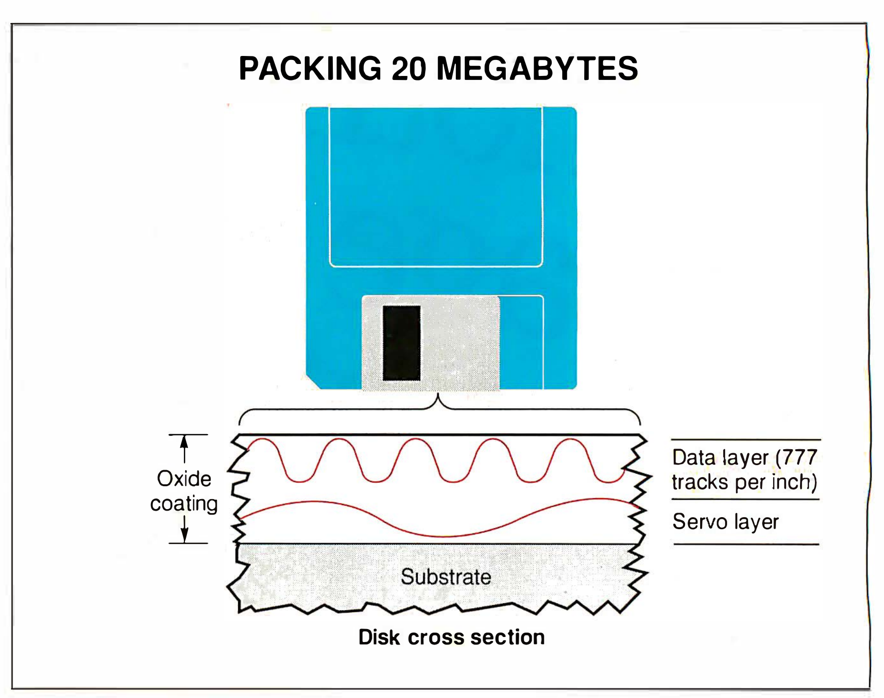
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BJ-10e

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The oxide coating on the Stor/Mor's floppy media is divided into two layers. The bottom, or servo, layer contains an embedded homing signal that guides read/write heads. Accurate head positioning in part allows the drive to densely pack data in the upper layer into 777 tracks per inch.

Special Formatting

Not surprisingly, the Stor/Mor drive comes with its own formatting utility. Because the positioning information is permanently encoded on the disks, the actual formatting is very fast—under a minute for the 20-MB storage space. In addition, the format utility allows you to partition the floppy disk into two logical drives in any combination that adds up to 20 MB.

If you use the Stor/Mor as your boot drive, the formatting utility also gives you the option of putting DOS files on the disk. But I ran into an annoying anomaly when using this option: Stor/Mor won't take system files off an existing hard disk. It insists that you have a bootable disk in your floppy disk drive A. Of course, if Stor/Mor is your only "hard" drive, that's where the files would have to be. But I would have liked to have had a choice.

The Stor/Mor drive is only usable with Brier's special disks. It currently won't read or write to 720K-byte or 1.44-MB disks. However, Q/Cor promises to have a version of the drive that will handle those formats later this year.

Speed Is Relative

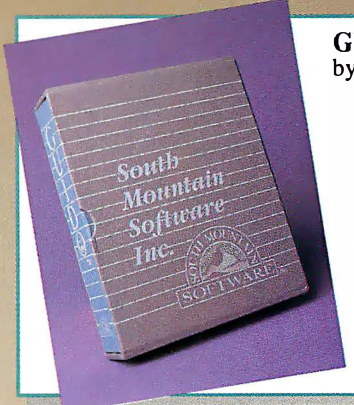
The Stor/Mor is faster than a standard floppy disk drive, but slower than a hard disk drive. I would have expected that, except that Q/Cor's marketing literature claims an average access time of 35 milliseconds, which is comparable to a standard hard disk drive. I found that to be a bit optimistic; most of the time, actual access time is three to four times that figure.

Packing more and more data onto 3½-inch floppy disks isn't a trivial undertaking. After what seems like years of fits and starts, many manufacturers are coming out with competing—and incompatible—subsystems. Stor/Mor is intriguing technology, but considering my installation problems, I get an uneasy feeling that it isn't quite there yet. It's a useful alternative to a standard hard disk drive for hard disk backups or for carrying large amounts of data in a portable package. For security, you can lock the disk away at night.

But for these capabilities, $895 is a considerable price to pay. In fact, for that, I could buy both a 40-MB hard disk drive and a 40-MB tape backup system and have money left over. Of course, the Stor/Mor is new technology, and new technology is usually expensive. But until its price falls considerably, I'll stay with my current storage technology. ■

Stan Miastkowski is a consulting editor for BYTE. He can be reached on BIX as "stanm."

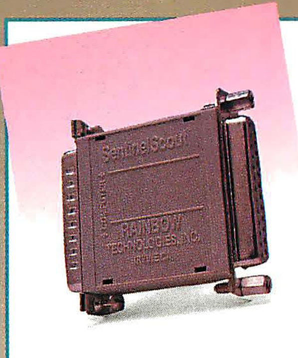
Professional developers require



GUIDO
by South Mountain Soft.

GUIDO is a powerful library of C functions which enables you to easily add graphical user interface objects to your application. Available objects include menus, windows, data entry, radio buttons, user definable objects and more. An event driven, object oriented windowing environment is also provided. GUIDO does not require any other graphics library and includes support for Borland Turbo C, Microsoft C and Quick C.

LIST: $249 **PS** Price: $229
LIST: $499 (w/so.) **PS** Price: $459
FastFaxts 42-050



SentinelScout
by Rainbow Technologies

The SentinelScout is a hardware key that attaches externally to the parallel port of an IBM PC or compatible to enable execution of authorized program copies. It does not interfere with printer operation, hard disk installs or backup copies. Featuring a fixed-response security system unique to each device, the economical SentinelScout offers a level of execution control perfect for lower-cost programs.

LIST: $295 (kit of 10 keys)
PS Price: $265
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	Cost
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386:ASM/LINK by Pharlap	485
DESQview 386	189
FoxBASE+/386	479
Instant C	769
Metaware High C - 386/486	875
NDP Fortran - 386	549
NDP C - 386	545
QEMM - 386	89
VM/386	229
WATCOM C8.0 386 Prof.	1155
WATCOM C8.0 386 Stand.	795

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PC Scheme LISP	85
TransLISP PLUS w/source	179
PDC Prolog Compiler	119

ASSEMBLERS

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Turbo Assembler/Debugger	109
Visible Computer:80286	85

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MS QuickBASIC V4.5	69
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ProRef by Hammerly	Call
QBase	139
QuickPak Prof./PDS	179

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WATCOM C8.0/286 Stand.	359

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Essential COMM by S. Mtn.	259
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QuickComm	129

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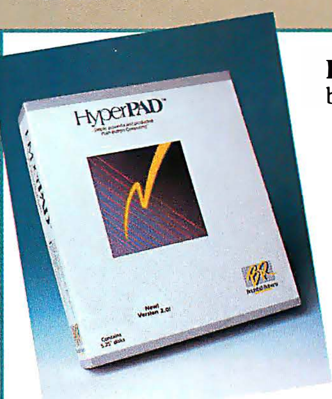
Clipper 5.0	550
dBASE IV	499
dBFAST/PLUS	325
dBFAST/Windows	329
dBMAN V	275
dBXL	209
FoxPro	495
FoxBASE + - V2.1	279
QuickSilver	399

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Cause Professional	719
CLARION Prof. Dev. V2.1	549
dbFast/Windows	329
D the data language	359
Magic PC	349
Paradox V3.0	479
R:BASE 3.1	499

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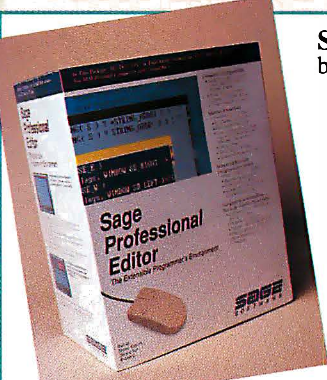
AdComm for Clipper	279
Artful.Lib	200
Buzzwords dAnalyst	269
CLEAR + for dBASE	179
dBase BlackBox	65
dBASE Online	129
BRIEF w/dBRIEF	Call
dBX/dBport	579
dGE 4.0	279
dQUERY	179
dSalvage	89
FLIPPER	179
FUNCky.LIB	179
Genifer - Code Generator	269
Net Lib	229
Pro Clip	125
R&R Relational Reportwriter	139
R&R Code Generator	129



HyperPAD
by Brightbill-Roberts

HyperPAD is an object-oriented application generator. HyperPAD gives DOS users the same capabilities as Tool Book, HyperCard and others, without the overhead. Use HyperPAD to create customized menuing systems for hard disks or Local Area Networks, computer based training systems, help systems tutorials, flat-file databases, hypertext information systems, front-ends and much more.

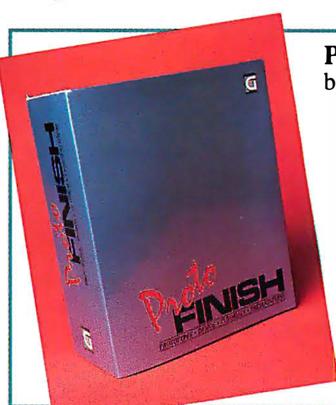
LIST: $150 **PS** Price: $129
FastFaxts 1104-006



Sage Prof. Editor
by Sage

The Sage Professional Editor is designed to create the applications of the 90's. It's highly configurable and has an advanced windowed user interface with integrated mouse support, on-line help and menu-driven commands. Has emulations for Brief, Vi, E ACS/ Epsilon and WordStar, and a virtual memory system for large files. Includes MS-DOS, OS/2 and Dual ode versions on 3.5" and 5.25" diskettes.

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FastFaxts 111-060



ProtoFinish
by Genesis Data Systems

ProtoFinish creates program prototypes, demos and tutorials. Contains screen design module for creating ASCII-based screens, memory-resident utility for capturing ASCII and CGA-VGA graphics screens, 4th-generation language with interactive/self-running capabilities for accurately simulating your program's look and feel, royalty-free run-time utility, and assembly language routines for incorporating screens in C, PASCAL, BASIC, and Clipper code.

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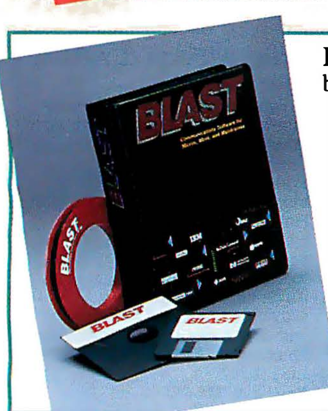
Object/1

by mdbs, Inc.

Object/1 is more than just another application development tool. It's designed specifically for graphical environments like Presentation Manager and Windows 3.0 to provide a comprehensive development environment. It features a Forms Painter which allows you to build and edit graphical forms which link to a variety of back-end database servers. Object/1 is a rich object-oriented programming tool which has more than 250 classes and 3000 methods.

LIST: $995 **PS** Price: $895

FastFaxts 1506-003



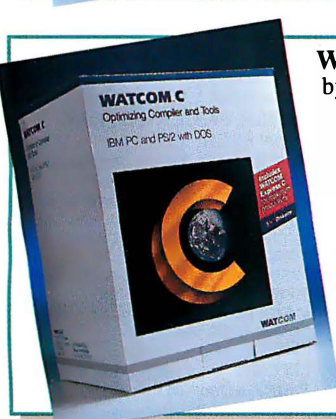
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BLAST puts powerful data transfer, remote control, scripting, terminal emulation, datacompression, and other communications magic into one product for PC, Unix, Xenix, VAX, Macintosh, and even mainframe communications... all with the same look, feel, menu interface, protocol, and script language! Easy for developers to link into existing applications for automated, 100% error-free data transfer and fast, reliable remote control.

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WATCOM C 8.0/386 Prof.

by WATCOM

WATCOM C 8.0/386 is 100% ANSI C optimizing compiler/runtime library for Intel's 80386 architecture, generating applications for 32-bit protect mode. Features include: protected mode version of the compiler; VIDEO full-screen source-level debugger; MS library-& source-compatibility; execution profiler; high performance linker; graphics library; supports MetaWare High C 386 runtime calling conventions; SAA compatible.

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SilverPaint	100
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PVCS Professional	659
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SPF/PC - V2.1	199
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C Utility Library	199
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Greenleaf SuperFunctions	239
Opt-Tech Sort	119
Turbo C Tools by Blais	109

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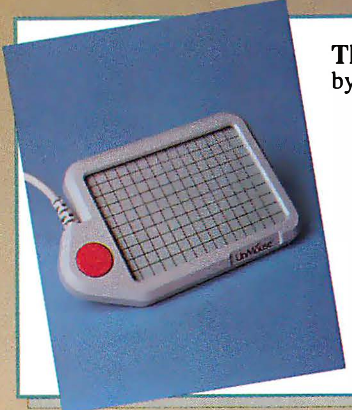
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Essential Graphics v3.0	349
GraphiC	319
GSS Graphics Dev't Toolkit	525
Halo	279
HSC Sunscan	289
LaserControl	139
Matrix Synergy Toolkit 3.0	349
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MetaWINDOW/PLUS	289
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EtherCard Plus	239
EtherCard Plus/A	349
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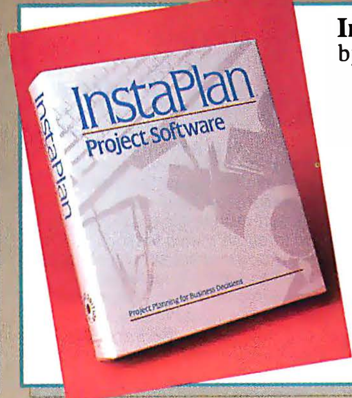


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Smalltalk/V-286	185
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Zinc Interface Library	179
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Zortech C++ Debugger	Call
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Systat & Sysgraph Combo	749
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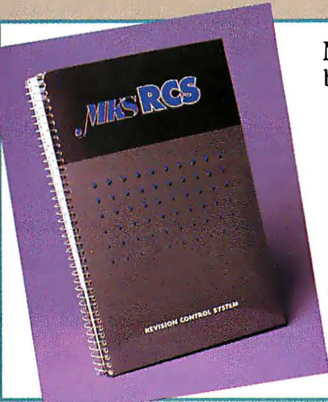
graphics-Menu	139
MetaWare Pascal 386/486	839
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Turbo Pascal 5.5 by Borland	109
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Turbo Professional	98
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HI-SCREEN XL Professional	289
JAM by JYACC	199
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VC Screen - painter	119
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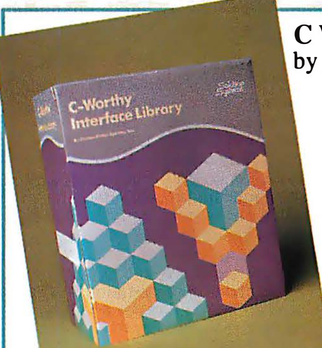
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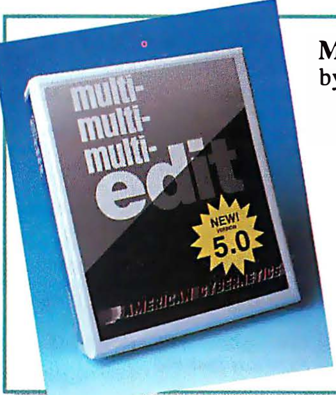


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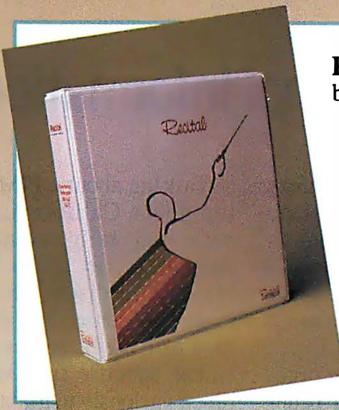
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Software Research, Inc.



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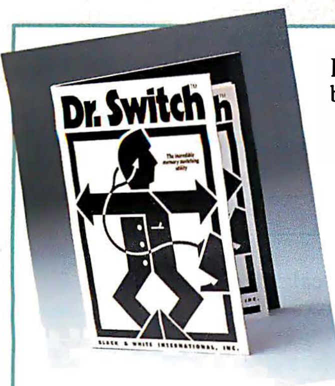
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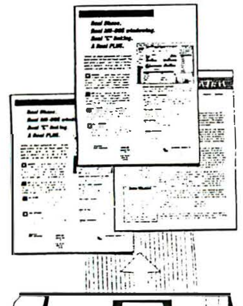


Dr. Switch-ASE
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Dr. Switch-ASE turns any size Dbase application into a RAM resident (TSR) program that occupies only 16-20K of RAM; Supports Clipper, dBASE III PLUS, dBASE IV, FoxBASE + and FoxPro. Dr. Switch-ASE includes Cut, Paste, Timer, Alarm and Macro functions. It supports Expanded and Extended memory and is fully network compatible.
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George Bond

REVIEW

Strictly for Personal Information

Personal Information Managers (PIMs) have had a tough time in the world. There's a passel of them on the market, but they don't sell very well. And like Rodney Dangerfield, they don't get no respect. It's a shame, because a PIM can be a very useful tool.

If you're normally a neatnik, an organized person who loves lists and timeline wall charts and loose-leaf notebooks with lots of schedulers, list pages, and dividers, a PIM can automate much of the drudge work that you now do manually. It can let you put more effort into the content and less into the structuring of your work.

If you're one of us organizational slobs, wallowing at a desk stacked with notes scribbled on old Moon Pie wrappers and coffee-stained file cards, with Post-it notes almost obscuring your terminal screen, a PIM can be even more valuable. It lets you move the mess—*as a mess*—into your computer in ways that allow you to actually find things later.

Naturally, no single information-management program could very well serve masters as diverse as neatniks and slobs. And that may be the heart of the PIMs' problem: People look at one or two PIMs and assume they all are about the same. It's not so.

Talking about a PIM is a lot like talking about California. Describing San Francisco really doesn't say much about San Diego, let alone Merced or Madeline. The discussion needs focus to make any sense, and the focus needs to deal with the listener's interests.

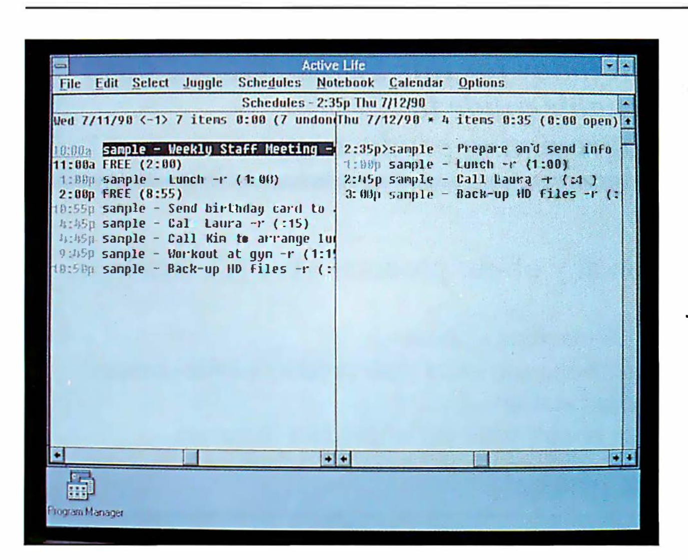
The specific functions that are combined variously to make a PIM are calendars, auto-dialers, telephone books and logs (records of conversations), to-do lists, prioritized to-do lists, tickler files, smart date-handling, and reports (see the table). There's also the ability to sort, filter, and interrelate your information and look at it in different ways. Some of the PIMs add to their utility by letting you run them as TSR programs.

To bring some focus to a discussion of PIMs, I've divided them into two general classes: free-form and structured. There are wide variations within these classes, but they describe the essence of how PIMs work.

Lotus Agenda, for example, is a free-form PIM. Agenda seems to have been designed to send would-be users back to tossing scraps of paper into a shoe box as an information-management technique. And it has to be one of the most difficult-to-learn programs that have ever been written. It is work, hard work, and a lot of it, to learn. But once you've figured it out, Agenda is indeed a powerful, flexible tool for managing many sorts of textual information. (For a review of Agenda, see "The Database Redefined," December 1988 BYTE.)

IBM Current, on the other hand, is a structured PIM. Current is a Microsoft Windows-based program. It would be a standout if it weren't for its limited record capacity (a category can have no more than 4000 items in it) and its field-size limit. The only required—and nonremovable—field in Current's records is limited to 25 characters for people and project names, and 16 characters for calendar, expense, task, and to-do entries. In all other respects, Current is a do-everything program that works well and is a pleasure to use. (For a review of Current, see "Jack of All Trades," March BYTE.)

The free-form programs reviewed here are askSam, Info Select, and MemoryMate. The structured ones are Active Life, Instant Recall, PackRat, and Who-What-When. (Incidentally, what is sold now as Instant Recall is not the same Instant Recall that was distributed as shareware several years ago. That program has been transformed into MemoryMate.)



Active Life

Active Life's smart calendar shows you at a glance, in bold type, your appointments and the time you have free. In light type, it suggests times to accomplish your tasks.

Active Life is the only shareware product of the group. It's available for Microsoft's OS/2 Presentation Manager (PM), Windows 3.0, Windows/286, or Windows/386, and in a run-time Windows version for DOS.

The heart of Active Life is its smart calendar. Unlike many of the PIMs, Active Life does not differentiate between tasks and appointments; it displays both on the same calendar. The rationale for this is that tasks take time and affect any schedule.

Most PIMs make you go back and forth from tasks and calendar views to see where you've committed your time. By displaying both tasks and appointments together, Active Life gives you a much clearer idea of what your time commitments are. This, I think, is an eminently sensible approach.

Active Life allows automatic repetitive scheduling (e.g., a meeting held at the same time daily, weekly, or monthly), alarms, and easy juggling of appointment schedules with a mouse or a keyboard. The program also automatically archives each day's records after all tasks are marked as done.

Active Life enhances the regular Windows card file for its notebook (the notebook is not available in the PM version). When combined with the telephone dialer, it becomes the communication module. Multiple notebooks are

supported, which helps in organizing textual information. You can create telephone books in the notebook as they are in Windows, and existing Windows card files and ASCII text files and databases can be imported directly to a notebook.

Data searches are done with simple text strings. Its reporting capability is limited to printing your daily schedule and a two-month calendar.

While Active Life doesn't have all the features of some of the other PIMs I looked at, it allows thorough control of your activities. And because it closely follows the Windows standard, it is a breeze to learn. In addition, because it is shareware, you can try it out before you buy it.



askSam

askSam can easily deal with big chunks of data, and its main menu, as shown here, gives you plenty of options for managing and updating the information files.

Handling large volumes of text is askSam's real strength. If your information comes primarily in big chunks, then you should give serious consideration to this program.

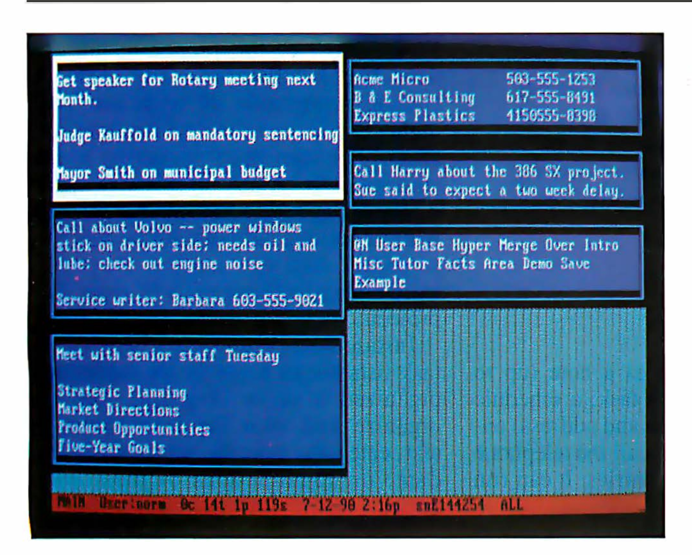
As with Agenda, askSam's learning curve is fairly steep. Although many basic operations are menu-driven, the more complex operations require programming in a language that is not simple. For example, here's a fragment of sort-request code:

```
{ELSE}@JOURNAL
{LONG JN[]VO[
{IF COUNT}IS[=0
PG[
{ELSE}
IS[PG[
{END}
```

You can enter information manually or by importing ASCII files. Records can link to external graphical files, and some hypertext capability is built in. You can also store data in a totally free format or a traditional fielded format. Its powerful reporting capability (using language like the sort fragment above) can generate printed ASCII files that other programs can also use.

Within a file, you can find information using sophisticated full-text search procedures, including variable word proximity (e.g., "locate only records in which search string 1 is in *x* relation to search string 2"). This feature allows you to easily find the notes on, say, the times you talked with Harry about the Acme Building project. It handles dates with a moderate degree of intelligence: Dates entered without a year are treated as being in the current year; months can be names with the minimum nonambiguous string (e.g., *N* for November, *JA* for January, and *JUN* for June); days within the current Sunday to Saturday cycle can be entered as *SU*, *MO*, *TU*, and so on. Multiple Boolean operators in a single-search command are supported. A hot key calls up an auto-dialer that can seek out telephone numbers on the screen.

askSam has no calendar/scheduler or telephone book as such, but it is possible to program them. The telephone book requires nothing more than a text file of the appropriate information and simple string searches. A very smart calendar/scheduler could be made using askSam's `calendar` command and saved macros to build ad hoc daily, weekly, monthly, or whatever views of text files containing the necessary information.



Info Select

Info Select emulates a desktop littered with several notes. As you browse from one note to another, the brightly framed "active window" moves to the screen location of the note you select.

If you are an inveterate scribbler of memos to yourself or a slave to Post-it notes, check out Info Select. This is Tornado Notes grown up. The concept is the same—manipulating electronic stacks of paper on your virtual desktop—and you can use it as a TSR program.

Data entry is totally free-form, with only kludges available to impose some structure. For example, you prefix dates in tickler-file entries with a ** string. A `tickler` command will search an entire stack for any entries with ** followed by the current or earlier date and will put what it finds in a new window. It's not elegant, but it works.

The program will also create a "linear calendar"—a year's worth of dates,

continued

PIM FUNCTIONS COMPARED

Each PIM uses a combination of functions to help you manage your information (●=yes; ○=no).

Name	Price	Minimum DOS version required	Minimum RAM (bytes)	Hard disk required	Calendar	Auto-dial	Telephone/ address book	To-do lists	Priority manager	Tickler	Smart dates	Alarms
Active Life 1.1	$149[1]	2.0	512K	●	●	●	●	○	○	○	●	●
askSam 4.2	$295	2.0	256K	○	○	●	*	*	○	○	○	○
Info Select	$99.95	2.0	256K	○	*	●	*	*	○	●	○	○
Instant Recall 1.2	$99.95	2.1[2]	512K	○[3]	●	●	●	●	●	○	●	●
MemoryMate 3.04R	$69.95	2.0	256K	○	○	○	*	*	○	●	○	○
PackRat 2.0	$395	3.0	215K	●	●	●	●	●	●	●	●	●
Who-What-When 2.0	$295	2.11	640K	●	●	●	●	●	●	●	●	●

* Free-form PIM; you can add structure to create the function.

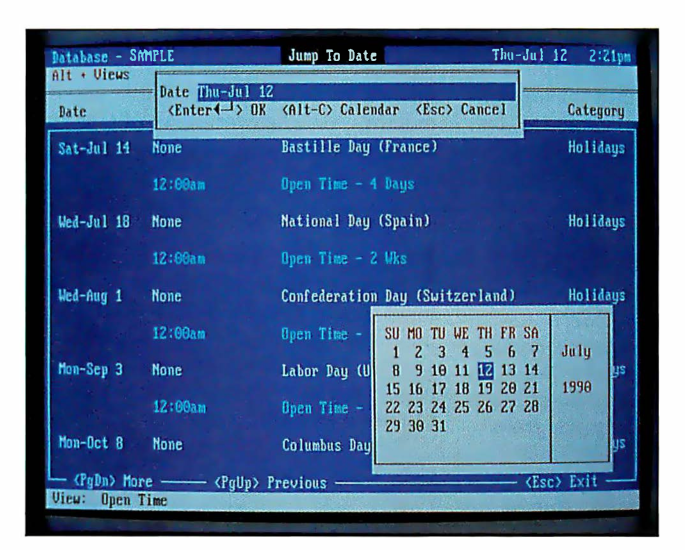
[1] Distributed as shareware and available on BIX.
[2] DOS 3.0 or higher for memory-resident operation.
[3] 720K-byte or 1.2K-byte floppy disk drive required.

listed one under the other—that can form the basis of a scheduling calendar. Again, it's pretty primitive, but it works.

You're on your own as far as telephone books go. This is no problem, since all you need to do is create lists of names and telephone numbers in any way you want. You can search on any part of the list, and an auto-dialer will place the call. The auto-dialer can seek out a telephone in any text on the screen, not just in something formatted as a telephone book.

To enter information into Info Select, you just open a window and start typing. You can also import ASCII text and simple database files. When you're done, press Escape twice to get out of the editor. Your note will be at the top of the current stack. To find information from the stack, you issue the get command and type the string you want to locate. When you press Return, Info Select creates a temporary substack of all the windows containing that string. You can then browse the stack with the up- and down-arrow keys. Report writing is limited, but it is adequate for memos and other nondemanding uses.

The only thing I don't like about Info Select is its default screen display, which emulates a desktop littered with many notes. As you browse from window to window, the brightly framed "active window" jumps around the screen as you change windows, rather than being anchored in one position. This makes scanning text a bit like following PacMan through its maze. Fortunately, you can change the default.



Instant Recall

Instant Recall's biggest strengths are its date handling and its pop-up calendar, which make it easy to refer to past or future dates without leaving the program.

Instant Recall is a very business-like program. Its command set is consistent. Its screens are clean and unambiguous. You can issue commands using an Alt-character key combination or with a mouse and pull-down menus. Instant Recall's structure is rigid but useful. You can enter information as a note (up to about 30 pages long), a task, a schedule item, or a people (name and address) entry. An auto-dialer can call the telephone numbers in the people entries. It can run as a TSR program.

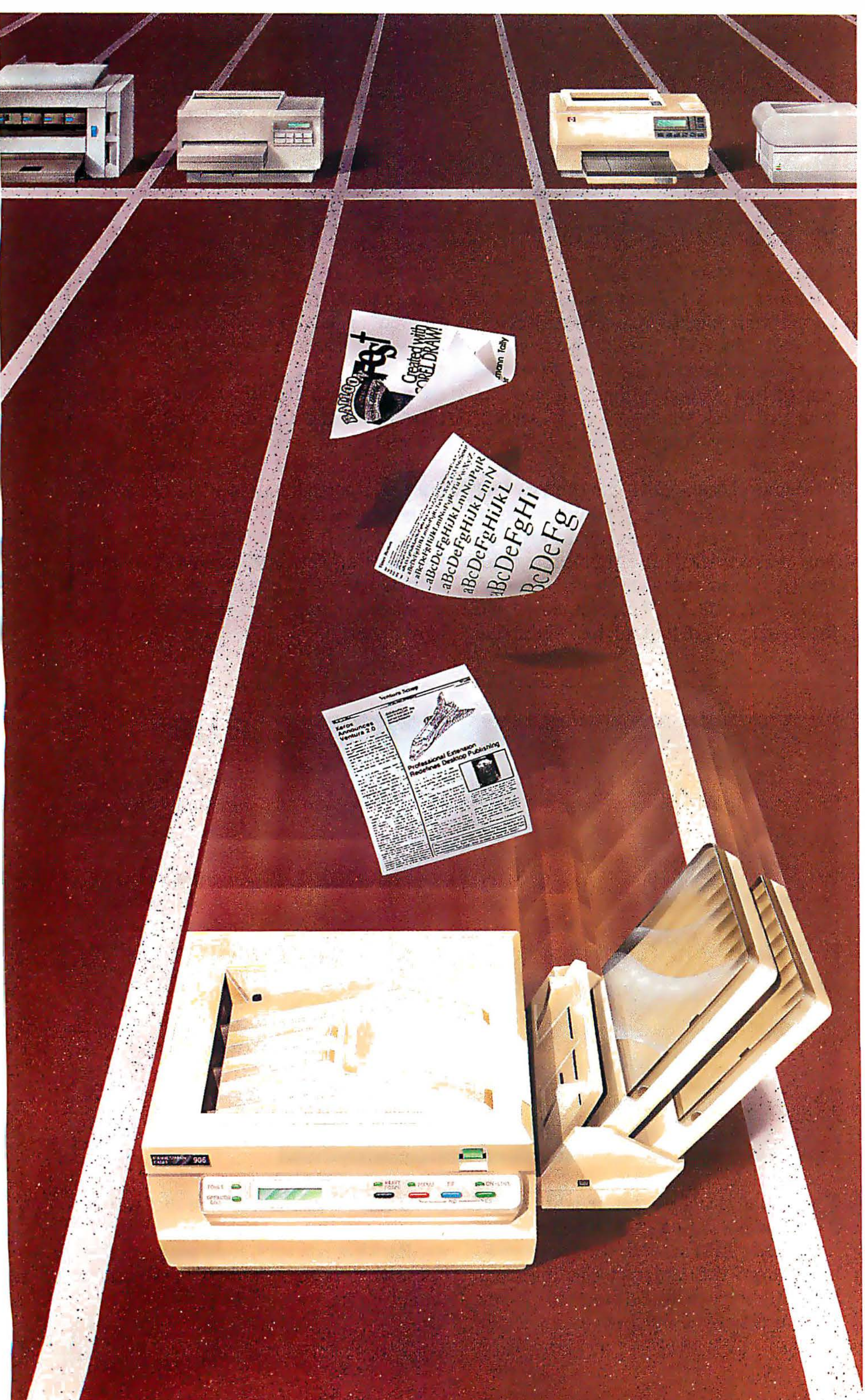
The built-in editor allows block moves and search and replace. You can use the clipboard for traditional cut-and-paste work. Conversion utilities are included to import ASCII, SideKick, Tornado, and MemoryMate files. You can search text using simple Boolean operators.

Dates are handled well. For example, the program knows how to convert "next Wednesday" to the proper month and date. Time handling is equally smart, including recognition of noon and midnight. Entries are checked for time conflicts. You can enter recurring events automatically. A pop-up calendar makes it easy to determine past and future dates without leaving the program or referring to paper. And you can use a timer to track and record time spent on individual projects.

Instant Recall supports schedules and task lists for as many as 64 individuals organized in up to 14 groups. You can organize and view the information by text, category, priority, person assigned, date, or combinations of these categories.

continued

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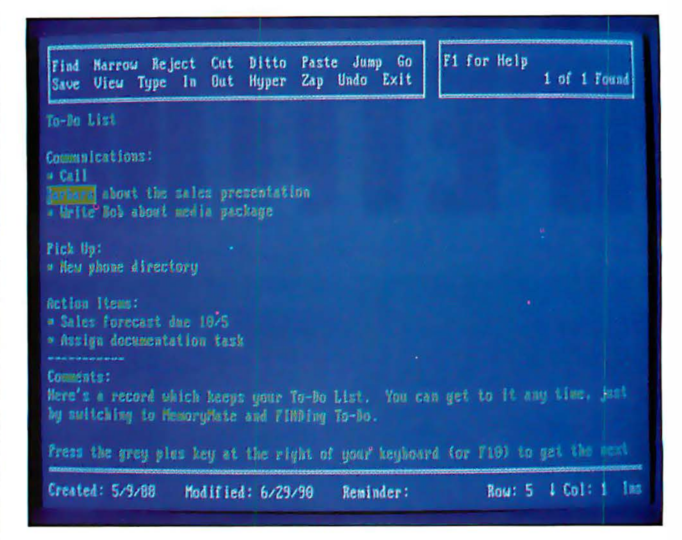
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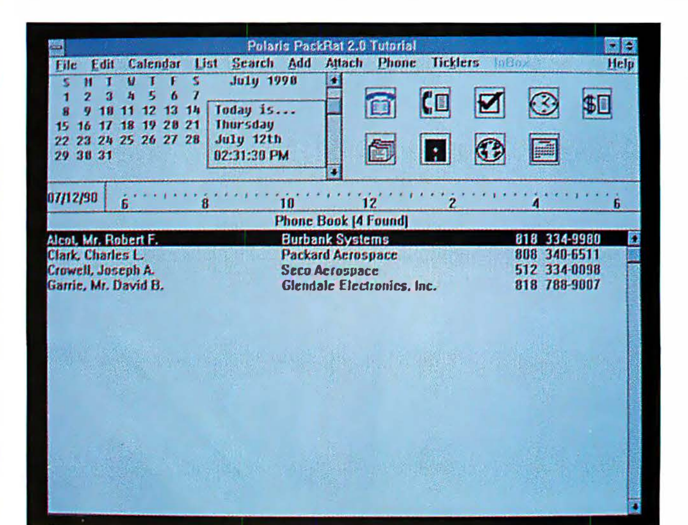
MemoryMate

MemoryMate can help organize your scraps of diverse information in ways that make sense to you, as shown here. For people who keep lots of bits and pieces of information, MemoryMate is hard to beat.

MemoryMate is probably the best information manager available for people who hate to organize themselves. It's not fancy. It doesn't have spiffy graphics. It doesn't beep at you to remind you of that 3:30 meeting. But you can take that mess you call a desk, stuff it into MemoryMate, and voilà! You're organized.

MemoryMate, which can run as a TSR program, indexes every word you put in it. You just type in the information or import it as an ASCII file from some other source. When you want to locate something, you issue the `Find` command and the string you are looking for. The string can be a word, text with wild cards, a date in the text, the date the material was entered or last revised, or a range of dates. You can use Boolean operators in the search string, too. You can also tell the program to display a memo on a specific date, and the memo will pop up automatically on that date.

However, what's important is that once you enter data, you can retrieve it with simple keyword searches, not special coding. If you're one of those people who have to deal with scraps of diverse information that comes in at random times in random ways, MemoryMate is hard to beat.



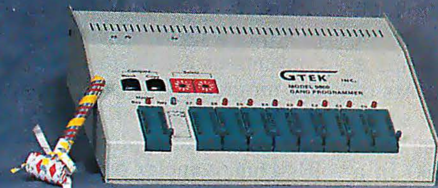
PackRat

PackRat takes full advantage of the Microsoft Windows environment to give you menus and icons that you can select that help make learning this big, complex program easier.

PackRat is a full-featured Microsoft Windows-based PIM. It was also the first major PIM written for Windows—long before IBM Current was released. It's a highly structured program. If you use PackRat, you must do things PackRat's way. Whether you like that way or not is a question of style, not of capability. PackRat is a very good program that does what it says it does, easily and reliably.

continued

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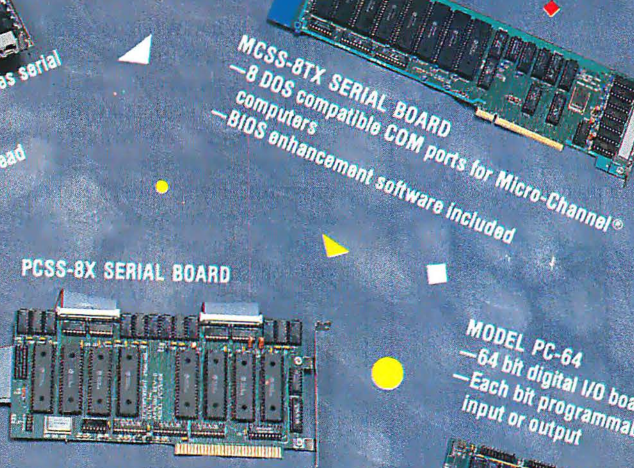


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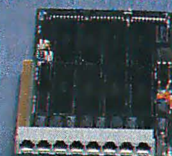




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PackRat can maintain a detailed telephone book and log information about conversations. In addition, it supports a keyword-indexed card file, with each card capable of containing 32K bytes of information. PackRat also maintains a prioritized task list, a calendar, lists of disk files, and expense records; it sorts, filters, and displays information from multiple areas (called facilities) in a single report; and it can construct relationships among information in various facilities.

It's easy to begin using PackRat. The program's close adherence to Windows conventions is a decided plus in learning the program. However, learning to tap the full potential of PackRat requires a fair amount of application on your part. It's a big, complex program.



Who-What-When

Who-What-When is primarily a task manager, but it also helps you keep track of a large number of people. And any of those people can be easily assigned to one or more particular tasks.

Who-What-When is clearly meant to be used by managers of projects involving many people. In addition to the usual personal calendar, it automatically creates and maintains calendars for every person and project entered into the program. These other calendars are updated automatically when you delegate tasks or set milestones for projects in your personal calendar.

Although Who-What-When operates in the foreground only, it includes a TSR alarm that can pop up over other programs. It has a built-in printing format for 5½- by 8½-inch pages; these pages fit in standard binders for paper-based personal organizers. You must supply the needed compressed-character codes for your printer.

Three programmable hot keys allow you to substitute, on the fly, your own word processor, spreadsheet, and telecommunications package for the built-in memo writer, calculator, and auto-dialer. Who-What-When also allows an unlimited number of milestones to be associated with a project, making tight controls much easier. In fact, you could say that Who-What-When is a project manager for very small projects.

Free-Form or Structured?

In deciding on whether a free-form or structured PIM best fits your needs, you should consider this: Free-form PIMs are probably better suited to people who take a more relaxed view of organizing their lives. Because such PIMs are free-form, there is no structure to figure out before you enter something—you just load the program and start typing. You can add varying amounts of structure to any of them if you want to, and you probably will. Totally free-form data has its limitations.

Ease of use is a strong point of free-form PIMs. There are exceptions, however. For example, askSam is relatively easy to get started with if you have any experience at all with computerized databases. But becoming skilled with askSam takes time and effort, because its powerful query language is also complex.

There is no consistent design metaphor for free-form PIMs. The askSam program can support records with formal

continued





COMPANY INFORMATION

askSam Systems
(askSam 4.2)
P.O. Box 1428
Perry, FL 32347
(800) 327-5726
Inquiry 889.

Broderbund Software, Inc.
(MemoryMate 3.04R)
17 Paul Dr.
San Rafael, CA 94903
(415) 492-3500
Inquiry 890.

Chronologic Corp.
(Instant Recall 1.2)
5151 North Oracle, Suite 210
Tucson, AZ 85704
(602) 293-3100
Inquiry 891.

Chronos Software, Inc.
(Who-What-When 2.0)
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(415) 626-4244
Inquiry 892.

Micro Logic Corp.
(Info Select)
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(800) 342-5930
Inquiry 893.

1Soft Corp.
(Active Life 1.1)
P.O. Box 1320
Middletown, CA 95461
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Inquiry 894.

Polaris Software
(PackRat 2.0)
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Escondido, CA 92025
(619) 743-7800
Inquiry 895.

fields as well as unstructured text. You can use complex Boolean searches and simple string searches to locate information. (Agenda uses data structures that are vaguely like fields, to which you can attach extended notes. In addition, Agenda can sort material automatically by keywords and dates and do simple string searches.)

Info Select is a hard-core scraps-of-paper system—its default screens even look like a littered desktop. It finds specific information using string searches.

MemoryMate mimics scraps of paper, too, but keeps them neatly out of sight until you call for them with simple Boolean searches. It supports forms with pseudofields (fields not as strongly typed as in a traditional database manager like dBASE IV or Paradox).

The structured PIMs offer diversity in their individual look and feel, too. The Microsoft Windows- and OS/2-based programs Active Life and PackRat, not surprisingly, are more graphical. But even character-based, structured PIMs, such as Instant Recall and Who-What-When, have their own personality.

An area in which the structured PIMs stand out is calendars and related tickler files. Much of what you do in your daily life is done repeatedly in predictable patterns: staff meetings on alternate Tuesdays at 10:30 a.m., semi-annual staff performance evaluations, and a mortgage payment that is due on the 23rd of each month. Each of the structured PIMs here lets you enter such information once and specify how it should be repeated. Then you can forget about any future data entry for those events. It's wonderful.

With such variety and richness of functions available, choosing a PIM for day-in and day-out use is tough. I have weaseled in my own life and use three different ones: MemoryMate, Current, and Agenda. I wish a single program would combine the features I want.

For me, MemoryMate is a sort of super notebook in which I quickly scribble down random thoughts and bits of information. Current is my daily-use PIM, functioning as an electronic Day-Timer, tickler file, people finder, and telephone book. Agenda is my tool for dealing with the large volumes of information I get electronically from on-line services and databases and for managing large-scale, long-term projects. If I were forced to depend on only one, it would be MemoryMate, because of its ease of use, flexibility, and TSR capability.

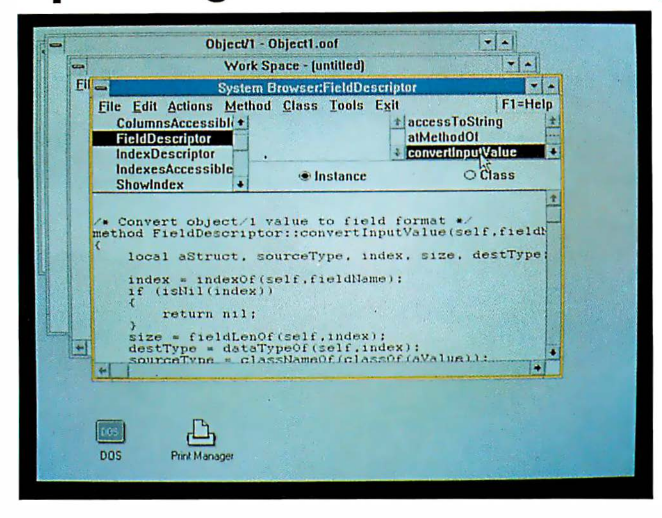
What you need in the way of a PIM truly depends on what you do. A PIM is a personal program. Don't look at just one or two and decide they aren't for you. Try a whole bunch of them. One is almost certainly what you have been looking for for a long time. ■

George Bond is a consultant in communications—electronic, traditional print, and person-to-person. He has more than 20 years' editorial and management experience with major information companies and is cofounder of BIX. You can reach him on BIX as "gbond."

Barry Nance

REVIEW

Speaking OS/2's Native Language



Object/1 is a pure object-oriented environment for programming under OS/2's PM. Its appearance is Smalltalk-like, with the object browser, source code editor, and interface builder integrated into the total package.

Graphical user interfaces, including OS/2's Presentation Manager, create object-oriented environments for users. Each mouse-sensitive region, be it an arrow on a scroll bar or an icon, is an object in the truest sense. Yet most PM programs are still being written in languages, such as C, that have no innate understanding of objects. As a result, programmers have to translate their designs to a non-object-oriented approach.

Object/1, a PM application development system from MDBS, is at the forefront of OS/2 software technology in several ways. The C++-like programming language is fully object-oriented. The forms painter tool for designing PM screens builds interfaces that require a minimum of procedural code to manage. Object/1 includes a relational database manager (called TBL), plus a tool for laying out the design of your relational tables. The source code browser understands the object-oriented terminology and mechanisms of methods, classes, instances, and inheritance. You can also use Object/1 to develop Systems Application Architecture–compliant user interfaces.



Object/1 version 1.0

Company
MDBS, Inc.
1834 Walden Office Sq., Suite 250
Schaumburg, IL 60173
(708) 303-6300

Hardware Needed
IBM AT, PS/2, or compatible with a hard disk drive and 4 MB of RAM; a mouse and a VGA display are recommended

Software Needed
OS/2 1.1 or higher

Price
$995

Inquiry 887.

The Rundown

I tested Object/1 using a 12-MHz AT clone running OS/2 Standard Edition 1.2 with 4 megabytes of memory and a Microsoft Mouse. Object/1 requires a minimum of 4 MB of RAM. If you choose to load the demonstration and tutorial files, it takes up about 4 MB of hard disk space.

The core of Object/1 is a 140K-byte kernel/interpreter program. This kernel runs an application-specific image file of compiled classes and methods. The default 780K-byte image file that is supplied with Object/1 provides the development environment in which you create applications. Each application that you develop consists of the application image file, any data files you need to distribute, and a copy of the kernel/interpreter program file.

The Object/1 development environment is comprehensive. It includes a set of browsers (object-oriented editors) for viewing and modifying classes and their methods. In addition to the screen and database design tools, the environment includes a debugger, tools for tracing the hierarchy of class and method relationships, a useful tutorial, and the source code (1.4 MB worth) for the built-in classes. Getting the class source code is equivalent to getting library source code when you buy a C compiler—a definite advantage, even if you only use it for reference.

The Object/1 documentation consists of a 130-page tutorial and a 790-page reference manual. The reference manual is broken down into sections: operations guide, developer's guide, TBL database interface, MDBS IV database interface, Structured Query Language (SQL) Server database interface, class reference (the largest section), and a TBL reference.

Although the tutorial warns that it is not a comprehensive introduction to object-oriented programming, I put it to the test by asking a C programmer friend to run through it and give me his comments. When he finished, he and I both agreed that this first introduction to OOP was more than adequate and that he was ready for more advanced, real-world programming.

In the class reference section, each class is described in terms of its superclass, its subclasses, its stability (likelihood of changing in later releases), and its methods. The methods (functions) of a class are shown as either class methods (those that you can use to create a new instance) or instance methods (those that you can use to manipulate an existing instance). The library of methods you get with Object/1 encompasses just about everything you might want to do under OS/2 and PM.

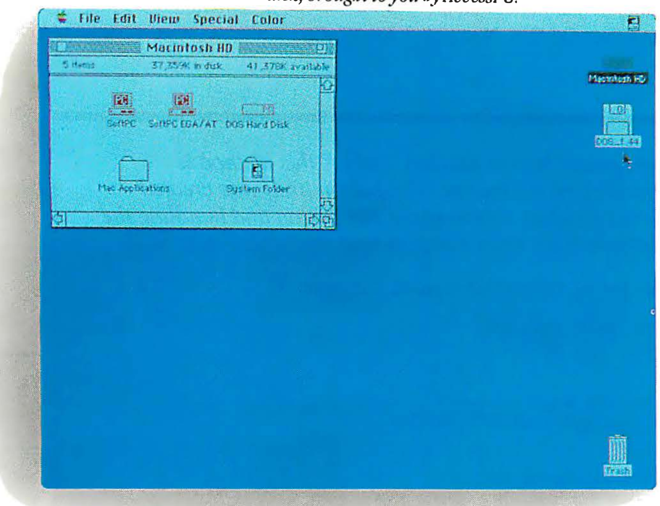
The class reference section is useful, but I found the descriptions of most methods too terse. To Object/1's credit, though, the supplied source code is an easy-to-use adjunct to the class reference. You can arrange and view the source files by hierarchical category or in simple alphabetical order. I also found the library source code to be well commented and modular.

The Language of OOP

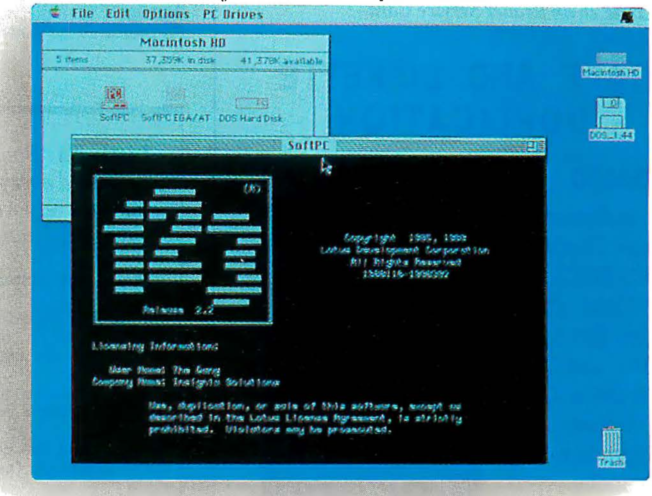
The Object/1 language is more like Smalltalk than like C++. Even so, programmers familiar with either C or C++ will find the transition to Object/1 syntax and semantics an easy one. The most difficult aspect of the adjustment for a traditional C programmer is the lack of procedural (non-OOP) facilities. While C++ adds OOP to an existing procedural language and lets you drop back to old-style C coding practices, Object/1 is a pure OOP environment. For example, it discourages global variables. And it does

continued

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Circle 147 on Reader Service Card

Listing 1: *Bound to a graphical button labeled "Add," this method is activated every time you click on the button. The button itself was created interactively with the forms painter. Creating the PM button and handling the associated action would have been more complex and time-consuming in C.*

```
/* Add the current information to the contact/company database. */

   method SalesLeads :: add (self, mp2, mp2)
   {
    local hPointer;

    /* Show an hourglass for the mouse cursor */
    hPointer = setPointer (systemPointer(SPTR_WAIT));

    /* add the record */
    addRecord (table, fillFromScreen(self));

    /* Reset the mouse cursor */
    setPointer (hPointer);
    return nil;
   }
```

not provide the means to code methods that are not associated with a particular class. Why? It's easy in C++ to fall into the bad habit of coding global variables and non-OOP functions, even though you intended at the outset to stay within the bounds of good object-oriented style. Bad habits come back to haunt you during the testing and maintenance phases. Most bugs and time-consuming workarounds are attributable to the non-OOP code. These pitfalls are not present in Object/1.

However, if you find pure OOP too restricting, Object/1 has an escape mechanism. You can easily interface to Object/1 code with dynamic link libraries. By supplying some functions in a DLL (you will need a separate C compiler to build it), you can, if you wish, develop a portion of your application in a procedural fashion.

Listing 1 is an example of Object/1 code. It is an _add_ method that is automatically invoked when the user clicks on the Add button. This automatic invocation is established in the forms painter. The _add_ method sends an _addRecord_ message to a relational table stored in the _table_ instance variable.

Designing and Using Forms

Besides letting you place push buttons, list boxes, dialog boxes, menus, entry fields, and other PM objects exactly where you want them, the forms painter uses your design to generate Object/1 source code that implements the screen you have laid out.

When a window control is activated at run time, the generated code makes the control behave predictably (e.g., list boxes know how to scroll, text editors know how to accept input, and push buttons can be pressed).

Controls pass data to your application through methods. Object/1 generates a source code template for each method; you then edit the generated source code to make it perform the specific task you want. For example, you might place a push button on the screen, label it "Add," associate it with a method called _add_, and then write the code given in the listing. At run time, when the user of your software clicks on the Add button, the method you have coded is automatically invoked.

Much of the productivity gain you realize under Object/1 is achieved in the forms painter.

Databases, Data Exchange, and Browsers

TBL consists of a library of methods for defining and manipulating data tables. Through them, you can create new tables and records and perform other traditional DBMS tasks. Record retrieval via multifield indexes is supported, as well as field-at-a-time updating. TBL provides record-locking and network error-trapping mechanisms so you can write multiuser applications that run on an OS/2-based LAN.

TBLDesigner is an Object/1 tool for designing your application's relational tables. You open TBLDesigner, a PM window like the rest of Object/1, by selecting Tools and then TBLDesigner from one of the Object/1 browser windows. As you define a field, you can specify the field name, a field description, access codes (for field-level security), field length, and data type. The data type can be one of the following: logic (Boolean), integer, numeric (float/double), or string. In addition, you can specify that one or more of the fields be an

continued



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index into the table you design.

Object/1 library routines for accessing MDBS IV and SQL Server databases are also supplied.

The Dynamic Data Exchange protocol consists of interprocess messages and guidelines that OS/2 PM applications can use to share data. Object/1 provides methods (in compiled and source code form) that you can use to signal other DDE-conforming applications.

Methods are also provided for the actual sharing of data. The classes related to DDE are the DDE class, DDE client class, and DDE server class. Some of the methods in these classes are _buildDDE_, _getFormat_, _postDataResponse_, _execute_, and _postData_. It's fairly easy to use these DDE methods to, for example, import and export data to and from such DDE-conforming PM applications as Microsoft Excel.

Object/1 uses the concept of a browser for the editing and inspection of source code. Fully integrated within the Object/1 environment, a browser can be used to collect a set of system-supplied and programmer-written methods into a project (application). A list of methods is displayed in a list box; you can see the source code for a method by simply selecting the method's name. You can elect to sort the contents of the list box alphabetically for easy searching or by class hierarchy.

The system browser is augmented by the heritage browser, the implementors tool, and the senders tool. You use the heritage browser to see the class name, the associated methods for the current class, and the superclasses for that class. The implementors tool displays the classes that contain a given method. You use the senders tool to see which methods use another given method.

Help for PM

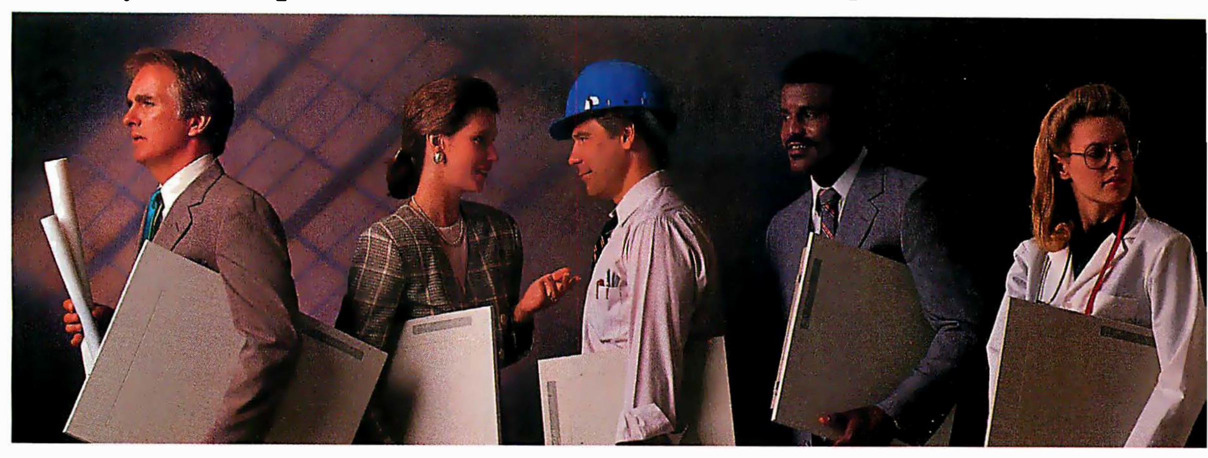
The inspector tool is a debugging aid that lets you view the instance variables of an object. The debugger tool is activated when the notifier tool displays a run-time error message, which in Object/1 can often be that a class receives an unrecognized message. A list box of message events is displayed; as you select an item, the source code of the method is shown along with the variables associated with the method. Selecting a variable displays its current value. You use the breakpoint tool to set breakpoints in a method. When a breakpoint is reached, a breakpoint dialog box appears, and you see the sequence of messages that have been sent, along with the source code of the methods and the values of variables associated with those methods.

I found the debugging aids supplied with Object/1 to be some of the friendliest and most helpful I have ever seen. Even when a run-time error occurred as the result of a coding error on my part, I could easily see the history of message events and the values of variables at the point of error. I could quickly figure out what I had done wrong.

If you have developed PM applications in C before, you know how time-consuming and error-prone it is to set up and manage a PM window and all its objects. The Object/1 environment relieves you of much of the dirty work and lets you concentrate on the application itself. It is also an interesting, useful implementation of OOP. ■

Barry Nance is the author of Network Programming in C *and works in the R&D department of PRC, Inc. (Hartford, CT). He can be reached on BIX as "barryn."*

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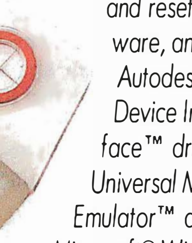
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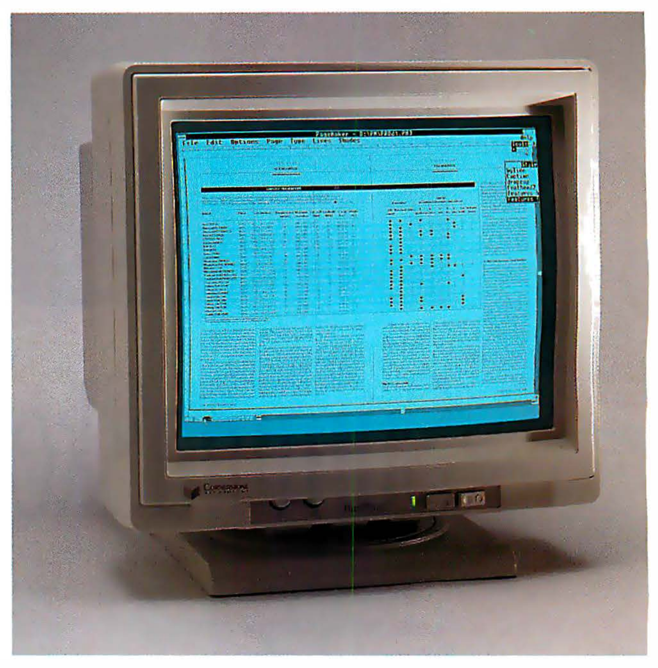
J. Scot Finnie

REVIEW

Dual-Page Duel: Two High-Resolution Monitors Square Off



Radius's 21-inch monitor includes a controller-based VGA chip and supports either PCs or Macs.



Cornerstone's DualPage PC offers 1600- by 1280-pixel resolution and an upgrade path to 4 or 16 gray scales.

While high-resolution, two-page displays may be a desktop publisher's most prayed-for peripheral, they're not just for desktop publishing anymore. Large-screen, paper-white monitors are also a staple for CAD, and they're making inroads in other areas. Spreadsheet users can increase productivity with a monitor that shows significantly more cells. Multitasking applications, such as Windows 3.0, make use of large-screen displays, too.

The bottom line is that high-resolution monitors, like Radius's new TPD/21 and Cornerstone Technology's DualPage PC, are becoming mainstream items in the PC market. With one or two caveats, both of these monitors perform up to specifications (see the table).

Two-Page Basics

Both of the reviewed monitors come with a dedicated 16-bit controller (which can also be used in an 8-bit slot). Each also has a tilt/swivel stand, plus video and AC inputs. Spartan controls consist of an on/off switch, an LED power-on light, and brightness and contrast knobs; I would also have liked to have vertical and horizontal size and positioning controls. Depending on which controller card you buy, the Radius TPD/21 runs with Macs or PCs, so it includes an A/B switch that alters the image size to conform to Mac or PC standards.

When they're the only monitor on a system, both products can display virtually any low-resolution software program in Hercules 720- by 348-pixel mode. But to see applications like AutoCAD and PageMaker in high resolution, you'll need proprietary drivers supplied by Cornerstone or Radius. Among the programs that both monitors support are Aldus PageMaker, Autodesk AutoCAD, GEM/3, Lotus 1-2-3, Microsoft Windows (at press time, both vendors had announced plans to ship Windows 3.0 drivers), Microsoft Word, WordPerfect, Xerox Ventura Publisher, and ZSoft Publisher's Paintbrush. I tested the monitors with Windows, PageMaker, 1-2-3, Ventura Publisher, and others, and encountered no problems with the drivers of either unit.

Radius's Contrasts

The Radius TPD/21 is a study in pluses and minuses. Its 21-inch screen is bigger than most in this product area—ostensibly a plus. But its top resolution of 1280 by 960 pixels is in the low end of the high-resolution spectrum.

In addition, the TPD/21 is effectively a monochrome monitor. Although it can display 16 shades of gray in the VGA mode, it is limited to black and white in the higher resolutions for which it was designed. Look for future incarnations to offer PC users gray-scale capabilities, as Radius currently does in the Mac market. But the TPD/21 offers an important plus for users of PCs and Macs: It works with both computers (the PC interface card costs $795; the Macintosh interface card costs $595).

I found the TPD/21 easy to install, despite its lack of a centralized installation utility. The documentation is clearly written and easy to follow. One drawback is that the TPD/21 driver disk separates driver utilities into subdirectories. Each subdirectory has its own README file that tells you how to install its particular driver. This requires you to root around more than with the installation utilities offered by most other display manufacturers. But it's more flexible—you don't have to run through the whole program to tweak the installation later.

One of the TPD/21's best features is its controller-based Paradise VGA chip and standard display connector. This allows you to attach a multiscanning monitor. With both monitors plugged into the board, the system automatically switches

back and forth from color VGA on the smaller monitor (when you access non-high-resolution programs) to the large screen (when you enter high-resolution software). You can rig up two monitors on the Cornerstone DualPage PC, but the Radius method is much easier to install and use.

The TPD/21's 1280- by 960-pixel resolution offers large, dark characters and shapes that have a clean, angular look. There's something evocative of the Macintosh look and feel in its overall color and patterning. That's not surprising, considering its heritage. Along with its 19-inch TPD/19 brandmate, the TPD/21 is the first Radius product for the PC.

The company's long association with Apple computers doesn't seem to have caused quirks for PC users. The only PC problem I found was in the BNC video connector: It's too big for the slots of the IBM XT and many AT-class computers. I couldn't get the BNC connector close enough to the card to be turned down and seated properly. Even so, the video quality was not affected, and the connector wasn't so loose that it ever fell off.

DualPage Gray Shades

The Cornerstone DualPage PC is a class act with some significant performance advantages. It offers a fairly high 1600- by 1280-pixel resolution. Also, while the monitor tested for this review was black and white, 4 or 16 gray shades are available optionally from Cornerstone. And for $875, you can upgrade your display adapter to provide 16 gray shades later on. Few programs or monitor drivers take full advantage of gray-scale capabilities, with Xerox's Ventura Publisher being a notable exception on the DualPage. You can expect this to change as the number of Windows 3.0 applications and drivers increases. Gray-scale capabilities are particularly important for desktop publishers who regularly scan photographs.

Besides accessibility to gray shades, DualPage provides a centralized and efficient driver installation program. But in general, installation is not as easy as with the Radius monitor. If you normally use a color monitor, you must use your system's setup program to default to monochrome. This may also involve a DIP-switch change. The documentation, while technically correct, is aimed at the 16-shade product, so some specific information, such as noting differences in program menus, is missing.

Images have a neater, trimmer, more finely rounded appearance on the DualPage than on the TPD/21. The only drawback was that characters were sometimes not as dark as I would have liked.

BYTE LAB

TPD/21

Company
Radius, Inc.
1710 Fortune Dr.
San Jose, CA 95131
(408) 434-1010

Hardware Needed
IBM AT or XT/AT compatible (the interface card is too large to fit into an IBM XT case)

Price
As reviewed (includes display, $1795, and TPD/PC interface card): $2590

Inquiry 852.

DualPage PC

Company
Cornerstone Technology, Inc.
1990 Concourse Dr.
San Jose, CA 95131
(408) 435-8900

Hardware Needed
IBM AT or compatible

Price
$2495

Inquiry 853.

Eyeball and Time Tests

Both monitors displayed some distortion. On the DualPage, the image area was not perfectly square, so images drooped downward slightly along the top left corner a couple of inches from the vertical edge. A similar flaw appeared on the TPD/21 screen, except that the distortion area was in the lower right corner. I've yet to see any monitor that doesn't have some distortion of this type, and neither flaw was particularly noticeable.

I determined screen-response times with scroll tests using PageMaker documents. I used a three-page document with text in several faces and fonts, Encapsulated PostScript art, and a TIFF photo. My test system was a 33-MHz 386 AT-class machine. I measured the time it took to scroll horizontally across a PageMaker fit-in-window-size two-page spread. In the one-page test, I started scrolling from the center position to the right edge of the right page. The two-page test started from the left edge of the left page and ended at the right edge of the right page. The screen-update test involved resizing a block of text in the upper left corner of the left page.

Both monitors completed the single-page horizontal scroll in 3.1 seconds. The DualPage performed two-page scrolls in under 7.4 seconds, while the TPD/21 pulled it off in just under 7 seconds. The two monitors tied at 7.8 seconds in redrawing a two-page screen after a type-size change.

Image size is the true measure of screen size. The 19-inch DualPage displayed a 17¾-inch image area; the TPD/21 spanned 19½ inches, which is roughly comparable considering their tube sizes. Even so, when it comes to showing two full pages on the screen, the two monitors are roughly equal. In PageMaker's actual-size page mode, I counted 13 horizontal PageMaker screen inches of a two-page spread on the DualPage,

continued

FEATURES

Although the Radius TPD/21's two-page screen is larger, the Cornerstone DualPage PC surpasses it in resolution and gray-scale capability.

Product	Screen size (inches)	Maximum resolution (pixels)	Refresh rate (Hz)	Video bandwidth (MHz)	Gray levels
Radius TPD/21	21	1280 × 960 (1152 × 882 on Mac)	65 (71 on Mac)	100	Black and white in high resolution; 16 shades in VGA mode
Cornerstone DualPage PC	19	1600 × 1280	67	200	Black and white (can be upgraded to 4 or 16 gray shades in high resolution)

while the TPD/21 showed only ½ inch more. When you consider that you might have as much as 2 inches of gutter between the two pages, you really need about 15 PageMaker inches to see the full width of a standard spread.

You might expect that from Radius's 21-inch monitor, but you won't get it. The reason is that the controller is exactly the same as the one used for Radius's 19-inch monitor, for which it was developed. So, rather than getting more of the page on the screen, you're seeing what the 19-inch monitor would show you, only about 10 percent larger.

For some applications, such as spreadsheets, this may be a boon. But for desktop publishing, it can be frustrating. This is generally not true on the DualPage. On the DualPage screen, an 8½-inch-wide page measured 8⅜ inches—an acceptable margin of error. Although the Radius 19-inch monitor wasn't tested for this review, it should have a similar margin of error, so desktop publishers concerned about accurate sizes should investigate the smaller model.

Both products performed admirably in showing side-by-side pages in PageMaker's fit-in-window mode. Times Roman text appeared legible to 9 points on the TPD/21; on the higher-resolution DualPage, I read Times Roman as small as 7 points. At actual size, I could read down to 6 points on the DualPage, and to 7 points on the TPD/21.

Customer service and technical support at both companies were prompt and accurate. Even when I gave the technical-support representatives a hard time by deliberately "misunderstanding" their instructions, they remained calm, polite, helpful, and knowledgeable.

The Winner Is. . . ?

In the end, there's no clear-cut winner. If gray-scale capability and high resolution are paramount on your list, the Cornerstone DualPage is your choice. However, if you run PCs and Macs side by side and can live without higher resolution and a sure gray-scale upgrade path, opt for the Radius TPD/21.

If you're not interested in gray shades and do not use a Mac, the decision becomes largely one of personal preference. All other things being equal, I would give the nod to the DualPage for its higher resolution. ■

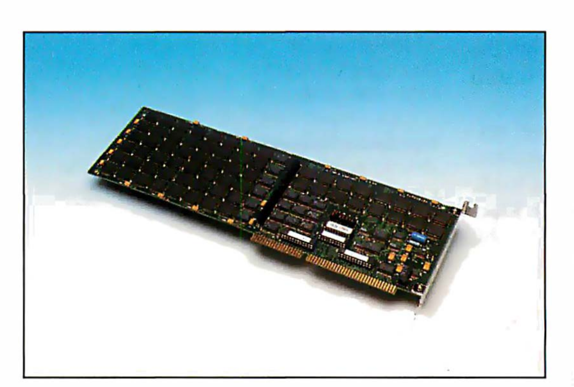
J. Scot Finnie is a freelance editor, writer, and consultant based in Ridgefield, Connecticut, who specializes in computer topics. He can be reached on BIX c/o "editors."

HARDWARE

Stanley J. Wszola

REVIEW

Flashdisk: Not Your Father's RAM Disk



Sixty-four Intel Flash chips make up the Flashdisk's memory. Similar to EEPROMs, the CMOS chips can be electrically erased and reprogrammed 10,000 times.

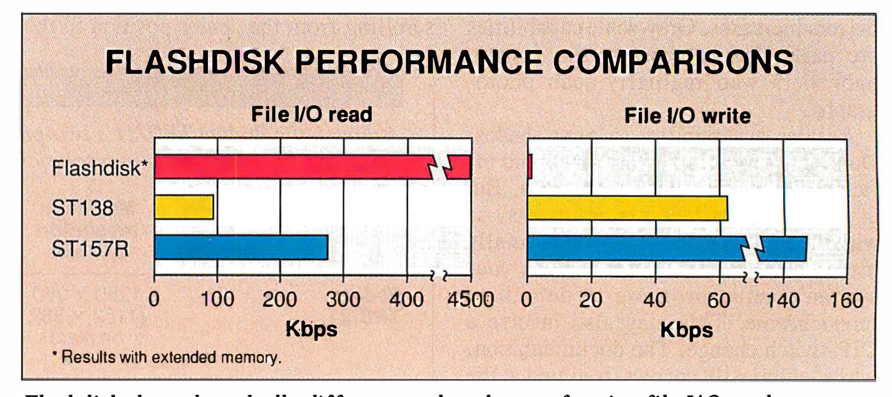
When I first received Digipro's Flashdisk board, I assumed it was just a very large (8-megabyte) RAM disk card. Wrong.

Flashdisk is a nonvolatile memory storage device that fits into a full-length 16-bit slot. It emulates a hard disk drive while also offering long-term data storage: The memory chips are guaranteed to hold data for up to 10 years. This makes it ideal for read-intensive applications where files are seldom, if ever, changed. Digipro recommends Flashdisk for storing large database files, compilers, graphical user interfaces, network-control software, and CAD libraries. In addition, you can use the board to store process-control software so that even if a computer shuts down due to loss of power or hard disk failure, your control program is safe. You can configure the Flashdisk board to become your boot drive. You can even transfer large volumes of data in solid-state form by just moving Flashdisk from one computer to another.

Faster Than an EEPROM

The Flashdisk memory is composed of 64 1024K-byte (128K-byte by 8-bit) Intel 28F010 Flash Memory chips. These CMOS chips are electrically erasable and reprogrammable devices. They function similarly to EEPROM (electrically erasable programmable ROM). But because of their CMOS construction, Flash chips offer much faster performance than do EEPROMs. Flash chips require 1 second for electrical erasure and 2 seconds for reprogramming, and they have an access time of 135 nanoseconds for high-performance reads. (A typical hard disk drive requires up to 85 milliseconds for a read operation.) According to Intel, you can erase and reprogram Flash chips a minimum of 10,000 times.

But saving files on the Flashdisk is a lengthy procedure, with the Digipro TSR



Flashdisk showed markedly different results when performing file I/O reads and writes under the BYTE DOS Benchmarks (version 2.0). Here, the BYTE Lab compares performance against the Seagate ST138 and ST157R hard disk drives. All tests were conducted with a 6-MHz AT clone; higher numbers indicate better performance.



Flashdisk

Company
Digipro, Inc.
102 Lowry St.
Huntsville, AL 35805
(800) 662-6802
(205) 536-2047

Hardware Needed
IBM PC or compatible with an available 16-bit expansion slot

Price
Base model with 2 MB of RAM: $1199
As tested with 8 MB of RAM: $3349

Inquiry 881.

software often displaying the message "Writing FLASH Buffer," while the Flash memory chips play catch-up with the rest of the computer. And once a file has been deleted, it is gone for good—it cannot be recovered with any utility program.

Installation is quite simple: You just insert the board into any 16-bit slot. Flashdisk comes with several software utilities and drivers. Among them are programs that format Flashdisk, a TSR program that automatically saves files to Flashdisk, and a program that restores the Flashdisk file access table if it's lost due to a faulty write operation. Device drivers include one that sets the I/O port and memory addresses and another that enables use of extended memory.

Also, there is FLASH.EXE, which installs or removes the TSR software that allows reads and writes to Flashdisk. Flashdisk requires 256K bytes of RAM for its buffer. FLASH.EXE can configure the board to use main system, extended, or expanded memory. You can use multiple Flashdisks in one computer.

An Odd Hard Disk Drive

The board behaves like an odd hard disk drive. The characteristics of the Flash chips mean that a write operation takes a long time, while a read operation is very quick. I ran some of BYTE's hard disk benchmark programs to compare Flashdisk's read and write speeds to those of hard disk drives. As the figure shows, the read times for Flashdisk are very fast, from over 15 to almost 50 times faster than the mechanical drives on the same or faster computers. The file I/O write times are very slow, with Flashdisk barely keeping pace at 1.63 kilobits per second. Digipro describes the Flashdisk as a ROWS (read often, write seldom) drive.

To test reliability of the data stored, I filled the Flashdisk with 8 MB of files and then removed the board. Whenever I reinstalled the board, all the files were intact.

With its base price of $1199, Flashdisk is an expensive storage device that I don't expect every computer user can justify. But for those who work with large database files, CAD libraries, and network-control software, its reliability comes at a reasonable cost, especially when compared to the price of uninterruptible power supplies and redundant hard disk drives that provide a similar degree of data security. ■

Stanley J. Wszola is a testing editor/engineer for the BYTE Lab. He can be reached on BIX as "stan."

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*The drama heightens as **The Shadow** easily slips into both interlaced and non-interlaced modes in one configuration.*

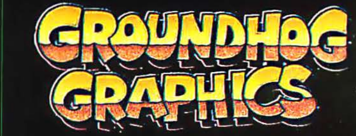
He adroitly upgrades from 256K to 512K to 1MB without skipping a beat. The chip count is concise . . . a reduced number to ensure reliability and long life. A seven year warranty is applauded.

*The play closes to a standing ovation as all users sing along **. . . Just Me and My Shadow.***

The credits roll with a long list of drivers, including Windows 3.0, AutoCAD 9 & 10, AutoShade, Lightning Zoom, AI (8514A), and many more.

The reviews are in . . . The Shadow earns international acclaim.

*The season is open and **The Shadow** will run continually. To witness the performance and relish the spectacular display of this virtuoso, call now for a theatre (dealer) near you.*



Circle 130 on Reader Service Card (RESELLERS: 131)

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- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 230-watt power supply.
- 12-month On-Site Service Contract provided by Xerox.△

***Commercial Lease Plan. Lease for as low as $286/month (433E) and $232/month (425E**).**

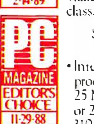
△Xerox Extended Service Plan pricing starts at $617 (425E) and $672 (433E).

	433E	425E
80 MB VGA Monochrome System	$7,899	$6,399
190 MB VGA Color Plus System	$8,699	$7,199
330 MB Super VGA Color System (800 x 600)	$9,599	$8,099
650 MB Super VGA Color System (800 x 600)	$10,799	$9,299

Prices listed include 4 MB of RAM, 100 MB hard drive configurations also available.







THE DELL SYSTEM
325 25 MHz 386
AND DELL SYSTEM
310 20 MHz 386.

The best combination of performance and value available in their class.

STANDARD FEATURES:
- Intel® 80386 microprocessor running at 25 MHz (Dell 325) or 20 MHz (Dell 310).
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM* expandable to 16 MB (using a dedicated high-speed 32-bit memory slot).
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high-speed static RAM cache.
- Page mode interleaved memory architecture.
- Socket for Intel 80387 or WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (6 available).
- 12-month On-Site Service Contract provided by Xerox.△

***Commercial Lease Plan. Lease for as low as $131/month (325) and $112/month (310).**

△Xerox Extended Service Plan pricing starts at $370 (325) and $251 (310).

	325	310
40 MB VGA Monochrome System	$3,599	$2,999
80 MB VGA Color Plus System	$4,099	$3,499
80 MB Super VGA Color System (800 x 600)	$4,199	$3,599
190 MB Super VGA Color System (800 x 600)	$4,699	$4,099

Prices listed include 1 MB of RAM. 100, 330 and 650 MB hard drive configurations also available.



THE NEW DELL SYSTEM
320LX 20 MHz 386SX.

One of the fastest SX's around.

STANDARD FEATURES:
- Intel 80386SX microprocessor running at 20 MHz.
- Standard 1 MB of RAM,* optional 2 MB or 4 MB expandable to 16 MB (8 MB on the system board)
- VGA systems include a high-performance 16-bit video adapter.
- LIM 4.0 support for memory over 1 MB.
- Socket for Intel 20 MHz 80387SX math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high-performance hard disk interface and diskette controller on system board (ESDI-based systems include a hard disk controller).
- 1 parallel and 2 serial ports.
- Enhanced 101-key keyboard.
- 200-watt power supply.
- 8 industry standard expansion slots (7 available).
- 12-month On-Site Service Contract provided by Xerox.△

***Commercial Lease Plan. Lease for as low as $98/month.**

△Xerox Extended Service Plan pricing starts at $261.

	320LX
40 MB VGA Monochrome System	$2,599
40 MB VGA Color Plus System	$2,899
80 MB Super VGA Color System (800 x 600)	$3,199
100 MB Super VGA Color System (800 x 600)	$3,399

Prices listed include 1 MB of RAM. 190, 330 and 650 MB hard drive configurations also available.





2·1·90

THE DELL SYSTEM
316SX 16 MHz 386SX
and DELL SYSTEM
210 12.5 MHz 286.

The perfect low profile mainstream computers.

STANDARD FEATURES:
- Intel 80386SX microprocessor running at 16 MHz (Dell 316SX) or 80286 microprocessor running at 12.5 MHz (Dell 210).
- Standard 512 KB of RAM, optional 640 KB, 1 MB or 2 MB of RAM* expandable to 16 MB (8 MB [316SX] and 6 MB [210] on system board).
- Page mode interleaved memory architecture.
- LIM 4.0 support for memory over 640 KB.
- Socket for Intel 80387SX (316SX) and 80287 (210) math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 3 full-sized 16-bit AT expansion slots available.
- 12-month On-Site Service Contract provided by Xerox.△

***Commercial Lease Plan. Lease for as low as $73/month (316SX) and $62/month (210).**

△Xerox Extended Service Plan pricing starts at $196 (316SX) and $158 (210).

	316SX	210
20 MB VGA Monochrome System	$1,949	$1,649
40 MB VGA Color Plus System	$2,449	$2,149
40 MB Super VGA Color System (800 x 600)	$2,549	$2,249
80 MB Super VGA Color System (800 x 600)	$2,749	$2,449

Prices listed include 1 MB of RAM. 2 MB versions of the above systems are available for an additional $100. 100 and 190 MB hard drive configurations also available.



THE DELL SYSTEM® 316LT 16 MHz 386SX.

This full-featured, battery-powered 386SX laptop costs less than most 286 laptops.

STANDARD FEATURES:
- Intel 80386SX microprocessor running at 16 MHz.
- Standard 1 MB of RAM, optional 2 MB of RAM* expandable to 8 MB (on the system board using 1 MB SIMMs).
- LIM 4.0 support for memory over 1 MB.
- Adjustable and detachable 640 x 480 VGA Liquid Crystal Display.
- One industry standard half-size 8-bit expansion slot.
- Socket for 16 MHz Intel 80387SX math coprocessor.
- 3.5" 1.44 MB diskette drive.
- 83-key keyboard with embedded numeric keypad and separate cursor control keys.
- 1 parallel, 1 serial, and external VGA monitor port.
- Connector for 101-key keyboard or numeric keypad.
- Connector for external 5.25" 1.2 MB diskette drive.
- Two removable and rechargeable NiCad battery packs utilizing Dell's "Continuous Power Battery System" (patent pending).
- AC Adapter.
- 12-month On-Site Service Contract provided by Xerox.△

***Commercial Lease Plan. Lease for as low as $120/month.**

△Xerox Extended Service Plan pricing starts at $303.

20 MB, 1 MB RAM	$3,199
20 MB, 2 MB RAM	$3,399
40 MB, 1 MB RAM	$3,499
40 MB, 2 MB RAM	$3,699





The Dell Systems 433E and 425E are FCC Class A devices sold for use in commercial environments only. *Performance Enhancements: Within the first megabyte of memory, 128 KB (316SX, 316LT and 210) or 384 KB (320LX, 310, 325, 425E and 433E) of memory is reserved for use by the system to enhance performance. Can be optionally disabled on 316SX and 210. All systems are photographed with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. **Payment based on 36-month, open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. DELL SYSTEM is a registered trademark and Dell and 425E are trademarks of Dell Computer Corporation. Intel is a registered trademark and i486, 486 and 386 are trademarks of Intel Corporation. †Source: Dataquest Inc. (SpecCheck Spring 1990). UNIX is a registered trademark of AT&T in the United States and other countries. Other trademarks and trade names are used to identify the entities claiming the marks and names or their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own. △On-site service may not be available in certain locations. Shipping, handling and applicable sales tax not included in the price. For information on and a copy of Dell's 30-day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract, please write to Dell Computer Corporation, 9505 Arboretum Boulevard, Austin, Texas 78759-7299, ATTN: Warranty.

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Not only does our laptop cost $2,500 less than their laptop, it also happens to give you a great deal more for your money.

Like a choice of 20 MB (which brings the price down to $3,199) and 40 MB hard drives.

Dell's unique "Continuous Power Battery System" that allows you to maintain your screen and save your data, even while you're changing batteries.

An industry standard half-card 8-bit slot that can be used for a network card or other advanced communications. And a dedicated slot for a Dell Data/Fax modem.

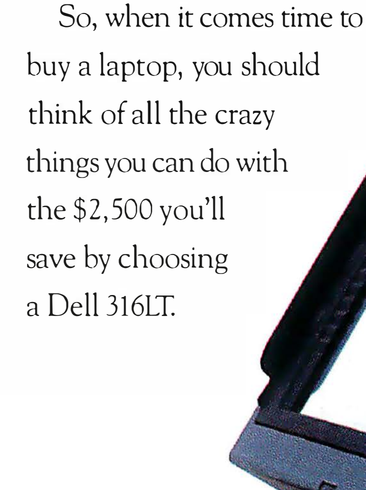
Illustrated documentation that's easy to read and understand, and is complete with Tutorial, Diagnostics and Utilities diskettes.

And last, but by no means least, the kind of award-winning service and support that has earned Dell the #1 rating in 6 out of 6 *PC Week* customer satisfaction polls for PC's. A *no questions asked* 30-day money-back

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technical support. And a full year of
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even if you're a thousand miles from
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comes to you.

Give us a call and we'll show you how easy it is to own the Dell 316LT through many purchase and lease plans that are available.

So, when it comes time to buy a laptop, you should think of all the crazy things you can do with the $2,500 you'll save by choosing a Dell 316LT.







YOU'D HAVE TO BE CRAZY TO BUY ONE OF THESE AWARD WINNERS.

$3,499

PC MAGAZINE EDITOR'S CHOICE 3·13·90

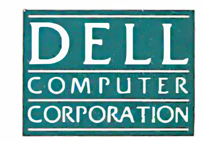
Dell 316LT
16 MHz
80386SX
40 MB
1 MB RAM
VGA
15.0 lbs

The laptop above is ours. The Dell™ 316LT. It comes with an Intel® 386™SX CPU running at 16 MHz. 1 MB of RAM, expandable to 8 MB, and a backlit VGA display. With a 40 MB hard drive it weighs 15 lbs. It won the *InfoWorld* Exceptional Value Award, and was one of only two 386SX laptops to win the *PC Magazine* Editor's Choice Award.

The one with the reddish screen on the opposite page is theirs. The Toshiba T3100SX. With the same configuration as our laptop. It didn't win the same award from *InfoWorld*. But it did tie with Dell for *PC Magazine* Editor's Choice Award.

Which is where the similarities stop.

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ABOVE AND BEYOND THE CALL

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BYTE'S 15TH ANNIVERSARY SUMMIT

Sixty-three of the world's most influential business and technology leaders predict the next 15 years of the personal computer industry

The personal computer industry started some 15 years ago, humbly, with a few primitive machines that today are museum pieces in every sense of the phrase. But their progeny—infinitely more varied, numerous, and powerful than anyone then dared imagine—now populate desktops the world over.

■

BYTE magazine also started 15 years ago—the only general-circulation computer publication to have been there from the start, witness to every significant event in the phenomenal evolution of the microcomputer industry.

■

This month, in celebration of BYTE's 15th Anniversary, we've set out to bring you something truly unique: We've asked 63 of the world's most influential people in personal computing business and technology to predict the next 15 years of the personal computer industry. Their answers are insightful and sometimes downright unexpected. And it's not idle chatter: These 63 gurus are part of a select group that will make this future happen.

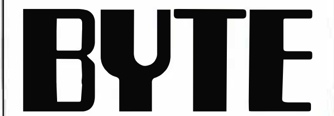
■

There's more, too. For example, along the way, these movers and shakers share insights into what makes the microcomputing industry tick today; what the new challenges are; what the opportunities are; what kind of hardware and software we'll be using in our business and personal lives in five, 10, 15, or more years; and much more. And to help put all this information in context, we've included a detailed time line, tracking the development of the personal computer industry from day one.

■

You'll find some great reading in the following pages, and we're very pleased to bring it to you. Thank you for being part of BYTE, and for sharing in this unique celebration.

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Editor in Chief



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BORLAND INTRODUCES TURBO PASCAL 5.5 WITH OBJECTS

Be Objective.

Turbo Pascal,® the world-standard Pascal compiler, adds Object-Oriented Programming with our version 5.5. We combined the simplicity of Apple's Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5, the object-oriented programming language for the rest of us.

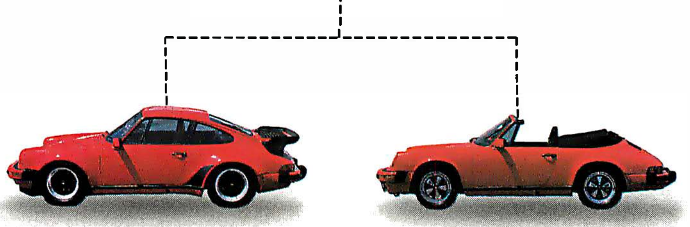
It's easy to extend yourself

If you're already programming with Turbo Pascal, it's easy to extend yourself from structured programming to object-oriented programming. And, Turbo Pascal 5.5 is the *only* compiler that is 100% source-code compatible with your existing Turbo Pascal 4.0 and 5.0 programs.

A fast object lesson

Object-oriented application programs more closely model the way you think. Objects contain both data and code. As in a spreadsheet cell, the value and the formula are together. Objects can *inherit* properties from other objects. For example, a Porsche Carrera inherits most attributes from the base model 911, but it also sports a whale tail.

Turbo Pascal 5.5's object-oriented extensions give you code that's easier to change, extend and support.



Inheritance provides powerful modeling capabilities by allowing objects to inherit attributes from other objects.

Support your objective

The Turbo Pascal® 5.5 Professional 2nd edition comes with the new Turbo Debugger® & Tools 2.0, which supports building faster, more reliable programs. Use Turbo Debugger to shake out the bugs, Turbo Profiler™ to pinpoint the execution bottlenecks, and Turbo Assember® to turbo-charge time-critical sections of your program.

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Turbo Pascal 5.5 and the Turbo Pascal 5.5 Professional 2nd edition are available *Now* at the dealer nearest you. Special upgrade prices are available to Turbo Pascal owners.* CALL NOW (800) 331-0877.

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Turbo Debugger & Tools
- Turbo Debugger 2.0
  - Object hierarchy browser and inspectors
  - Reverse excecution
- New Turbo Profiler
- Improved Turbo Assembler 2.0



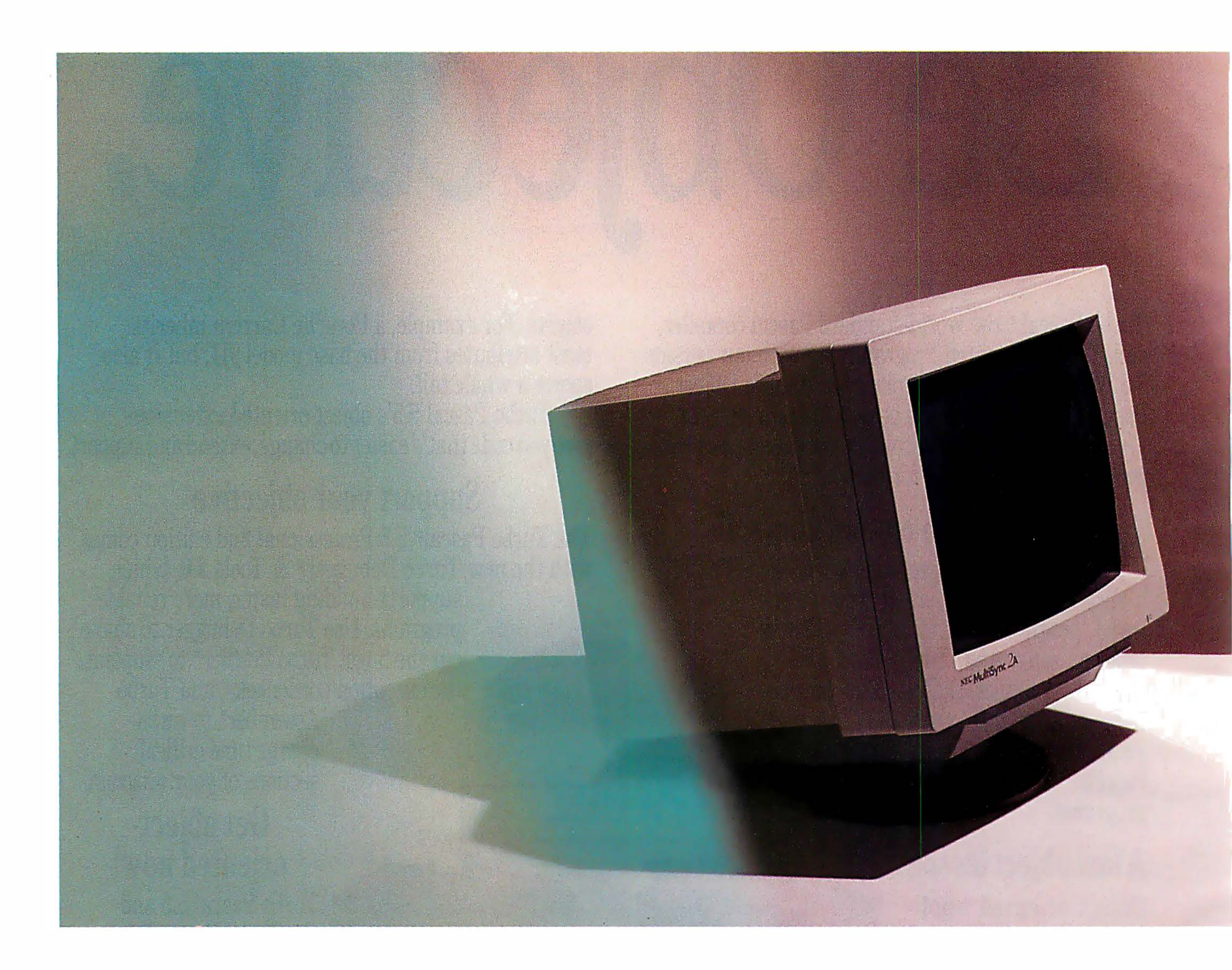
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On the left, the best-selling VGA monitor. On



The MultiSync® 2A is one monitor that performs like two. On one hand, it's an uncompromised VGA monitor that works so well, VGA users have made it the best-selling 14" VGA color monitor in America.

On the other hand, the MultiSync 2A is also an equally uncompromised SuperVGA monitor, providing the perfect upgrade path to a standard that, at 800 x 600, gives you 56% more resolution than VGA.


JANE MORRILL TAZELAAR

W E L

Contents

Leaders of industry, top academicians, and leading industry commentators come together in these pages to provide their unique perspectives on the microcomputer industry of the future.

This landmark project began with a list of questions that covered a broad spectrum of topics. They range from the future of the industry to the possibility of Marshall McLuhan's "global village" becoming a reality; from why software seems to lag so far behind hardware to the usefulness of neural networks, chaos, and fuzzy logic in the future; and from expected breakthroughs to bottlenecks and limitations in technology—13 different subjects in all.

To this list of questions, we added a list of more than 60 of the most creative and influential minds in the industry. What a combination! As you will see, it led to some spirited comments, agreements, disagreements, and quantities of fascinating reading. It's been an exciting and challenging project for BYTE to find and talk with these "movers and shakers" and to present their views on these subjects to you.

In addition to the questions BYTE asked, many of these experts mentioned special projects of their own, special interests that occupy them. The Insights located between the various BYTE Summit questions present those unique viewpoints from the industry's elite.

One of the people we spoke with was the late Robert Noyce. You often hear the phrase "a gentleman and a scholar" bandied about, but in this case particularly, both were true. Bob Noyce was one of the great gentlemen of our industry, and his intellectual accomplishments are legendary. We are pleased to be able to present some of his final comments on the future of computing, a future which, sadly, he will miss. As one of the fathers of our industry, however, he will never be forgotten.

We discovered many fascinating facts about the people we talked to, and thus about the industry. For one thing, while more of them use 286- and 386-based machines than Macs at work, at home they have more Macs. For another, we found quite a few new business opportunities for the would-be entrepreneurs among you. In addition—well, I'll leave the rest for you to discover as you read the pages that follow. Anything further that I could say would simply be soda and Cheez Whiz in contrast to the fine wine—correction, make that champagne—and caviar that you'll find in the pages of the BYTE Summit.

—Jane Morrill Tazelaar
Senior Editor, State of the Art

J. MORRILL TAZELAAR PHOTO: PAUL AVIS

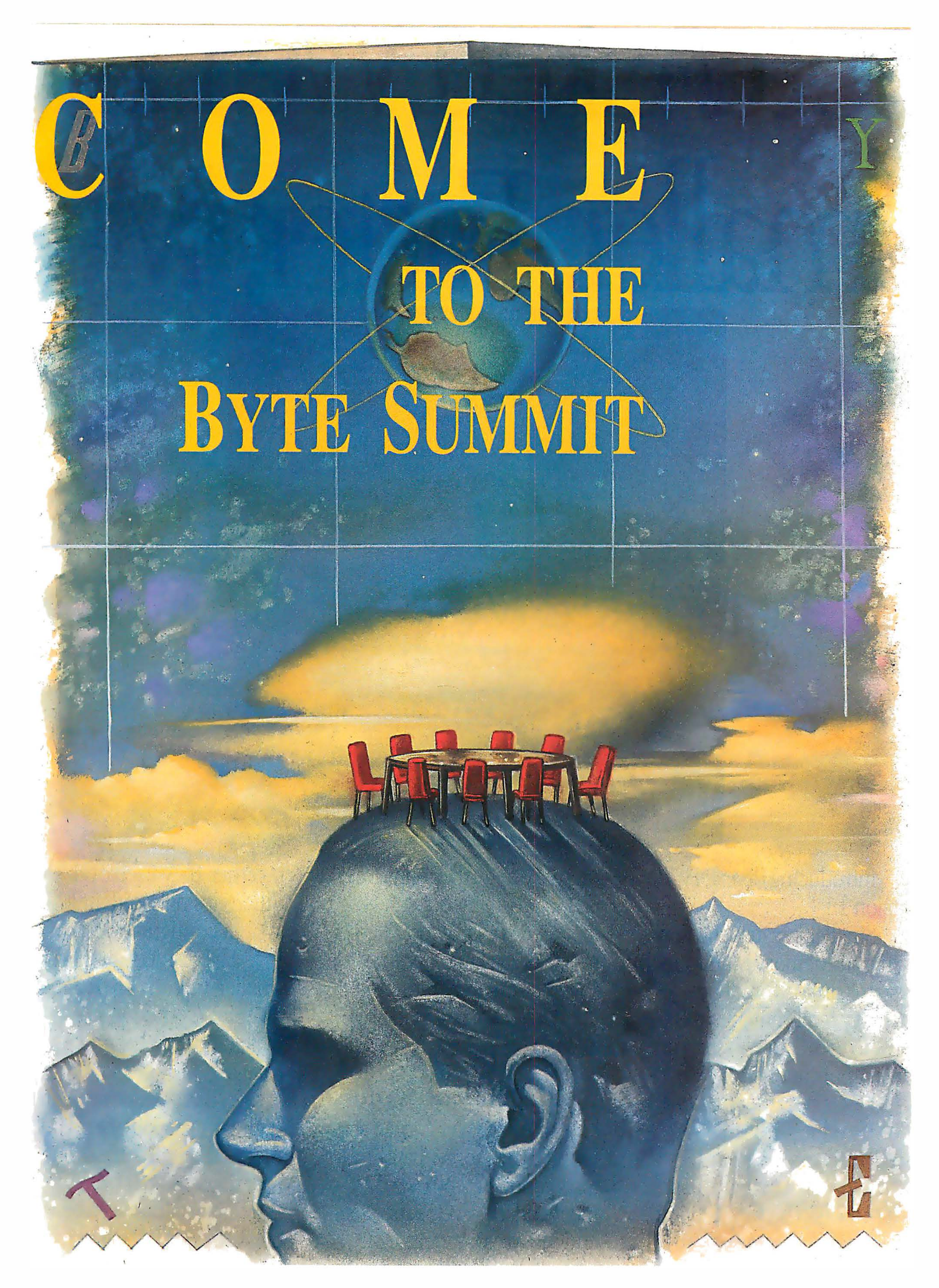
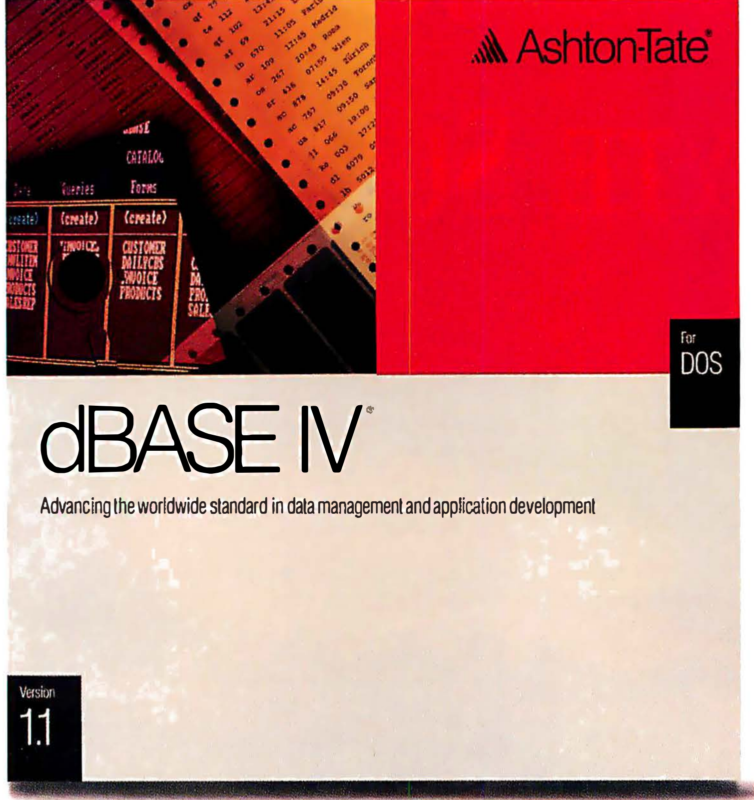


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You Asked. We Liste
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Introducing dBASE IV® version 1.1.

Smaller because the new Dynamic Memory Management System (dMMS)™ reduces memory requirements from 516K to 450K. So you can run larger applications.

Faster because the same dMMS reduces dBASE IV's need to access your hard disk. On top of that, the new built-in Disk Caching Option uses extended or expanded memory to further improve disk performance.

More reliable too. Thanks to one of the largest pre-release (beta) testing programs ever conducted for a PC database.

Tested By Some Very Independent People.

dBASE IV version 1.1 was found to be more reliable in tests conducted by over 2700 independent developers, users and MIS departments. All together, they used over 1000 different single and multi-user system configurations.

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Which means you can now start working faster and more efficiently than you ever have before.

Especially since you can operate dBASE IV through

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the powerful Control Center interface.

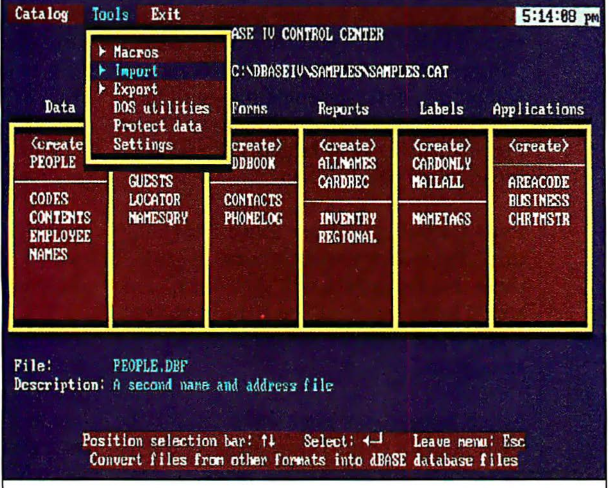
Now Anyone Can Use dBASE IV.

The Control Center is powerful because it's so simple. It's like a window to your data that you work with intuitively.

It gives you access to What-You-See-Is-What-You-Get (WYSIWYG) Design Tools that work through simple pull-down menus. The tools let you easily create custom forms, reports, labels and databases—without programming a single line of code. In addition, there's Query By Example (QBE) for quick answers without any programming—even if all your data is spread across multiple databases.

The Design Tools ensure that first time users will be up and running quickly, and that experienced users will realize high productivity gains.

In fact, even beginners can develop complete applications



The Control Center provides access to Design Tools that let you easily manage data without any programming.

automatically by letting our Applications Generator easily tie together everything they've created with the tools.

New Developments For Developers.

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Free, unlimited telephone support. (Your only charge is your toll call.) So see your Ashton-Tate® dealer today. Or call 1-800-437-4329 ext. 1403 for more information. Better yet, dBASE III PLUS® users can call 1-800-2-ASHTON for an immediate upgrade. Registered dBASE IV version 1.0 users will get a free upgrade.

Call now and tell us what we can do for you.

You can rest assured, we'll be listening.



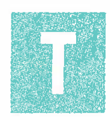
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THE BYTE SUMMIT

FUTURE DIRECTIONS

Where do you think the microcomputer industry is heading in the next five, 10, 15 years?



The only thing that has consistently grown faster than hardware is human expectation.

—Bjarne Stroustrup

Jim Manzi ***(see biography, page 292):*** There's no question that it's heading, in a sense, to dominate the entire computing landscape, which, in some sense, it already does. I think the dominance of microcomputing—personal computing, workstation computing, desktop computing—will be so overwhelming five years from now, at an ever-increasing rate, largely because it's a broad-based phenomenon.

Paul Carroll ***(see page 230):*** I certainly think the industry will continue to grow. I think that the growth will slow down. This year it looks like it will be 10 to 15 percent, and it might even get into the single digits at some point.

Mitch Kapor ***(see page 269):*** I think the basic outlines of the future shape of the industry are already visible today. I don't think there's going to be the kind of rampant change we've seen earlier. In fact, I think we haven't seen rampant change. The thing that sits on your desk today pretty much looks like the kind of thing that sat on your desk almost 10 years ago—if you had one on your desk. It's just a lot more powerful. It's heading right for the mainstream—it *is* the mainstream.

Dick Shaffer ***(see page 340):*** As far as machines based upon microprocessors [are concerned]: It's the dominant technology, as far as I'm concerned, over the next several [years].

Bill Joy ***(see page 262):*** Except for very-large-scale scientific computers, which may use special-purpose cellular hardware or neural nets or some sort of other architecture, all computing will be done with microprocessors. Certainly, all interesting computers will be micros, so the microcomputer industry essentially will equal the computer industry.

Tom McWilliams ***(see page 294):*** Today, what is a workstation and what is a PC are merging. Workstations are continuing to drop in price to the point where today you can buy some workstations for less money than your large PCs. So I think that the hardware distinction between a workstation and a PC is blurring. PCs and workstations have different software, where typically workstations are Unix-based and PCs [use] MS-DOS or Apple software.

Niklaus Wirth ***(see page 366):*** Well, microprocessors have certainly changed also life in academic institutes and research as well as in teaching. In teaching particularly, we have changed from the use of large computation centers to the individual workstations, and that I am sure is here to stay.

BYTE: ***What about the power of the hardware? Will that increase significantly? Or have we gone about as far as we can go?***

Gordon Campbell ***(see page 229):*** In the last decade, which is about as old as the industry is, we've gone from fairly crude tenth-of-a-MIP machines to 5- to 10-MIP machines as average PCs now. In the next decade, we're going to see microprocessors, basically, hooked up with more than one in a box. We will have true multiprocessing, and that will allow us to push into the 100- to 200-, 300-MIP category, still very cost effectively. On the high end, I think you're going to see the use of multiple processors. On the low end, we're going to see the true integration finally of the PC architecture and the microprocessor into a single chip.

Michael Slater ***(see page 340):*** I think that there are a lot of things that are pretty obvious; the amount of memory that people expect to have in their typical PC will be 4 megabytes in the next couple of years, and probably 8 to 16 megabytes within five years. That's going to be important as people go to graphical user interfaces, and more and more imaging-oriented parts of their software, and are doing multitasking, and are doing networking, running bigger and bigger and more complex applications.

Stewart Alsop ***(see page 227):*** Bigger, faster, cheaper. I'm serious about that. Obviously, where it's headed is where it's been heading for the last 10 years, which is [to] more and more functional and capable computers.

Gordon Bell ***(see page 228):*** You can take any scenario of what everybody has today and just run that out, minimally giving them a factor of 10 more.

ILLUSTRATION: CATHARINE BENNETT

Donald Knuth *(see page 282)*: People in my department are saying that computers are going to double in speed every year until 1995, and then they're going to run out of ideas. But we've got another factor of 30 or something to look forward to in that time. And then they will have squeezed out all of the slop.

John Cocke *(see page 235)*: Well, I feel that we'll have very dense memory, and [we'll] have much, much larger memory on the desktop. The machines will probably be equivalent to, say, large scientific machines, have any kind of features you want, like vectors and so forth, because they will be very fast. That's what I envision in the next, maybe less than 10 years.

Michael Slater: Actually, I think that in most all of these things you can actually look at where workstations are today, and PCs will be there within a few years in terms of the memory size, the display resolution, and built-in networking.

Bill Gates *(see page 250)*: Well, the vision Paul Allen and I had when we started the company was: A PC on every desk and in every home—the tool of the information age to let people see the information they're interested in and try out new ideas—and really nothing has changed our view of that. It was predicated on processors getting faster and software getting better, and all these advances sometimes take longer than we expect.

Bjarne Stroustrup *(see page 352)*: That's a huge question. I think the answer is [that] the PCs are going to be more powerful. That doesn't mean nirvana, because people seem to soak up cycles faster than the hardware manufacturers can build them. The only thing that has consistently grown faster than hardware in the last 40 years is human expectation.

Jack Kilby *(see page 272)*: In 15 years, you will be able to do anything you want to.

Jerry Pournelle *(see page 326)*: I said in BYTE, in the first issue I wrote in, that by the year 2000, anybody in Western civilization would be able to get the answer to any question that has an answer. I see no reason to change that prediction. Gates' notion that there will be a computer on every desk and in every classroom is absolutely right. The information revolution is just proceeding apace. There is nothing that surprises me in that sense, because I said it all 10 to 15 years ago, in BYTE.

BYTE: ***To get a little more detailed, how do you expect semiconductors to evolve? And what will be the effect of that evolution?***

Jack Kilby: As far as integrated circuits are concerned, we're on our way down to 0.7- and 0.5-micron lines, and we will see those happen.

Bob Noyce *(see page 318)*: Well, I see a continued trend of bigger, faster, better machines that can cram more and more onto a chip for another decade, but then we'll have to take a look at it. You do see some barriers arising, but still, those barriers have been about a decade away for some time. As we get more experience, we find ways to move those barriers back about 10 years. So I think that it will last another 10 years or so.

Lee Felsenstein *(see page 246)*: I've come to realize that as long as the chips are as cheap as they are, you can afford to waste some of the capability. When I say waste, I mean you don't design something from the ground up that makes use of 100 percent of the capability. Maybe it makes use of 40 percent of it. But then, you figure out ways to make that other 60 percent available when people want to have it available. That makes it a personal computer.

Ken Olsen *(see page 318)*: The same chip goes into the workstation, the desktop server, the bigger one, and the minicomputers. And they all have the same chip in them and therefore run at about the same speed. But one goes up close to $1,000,000 and one goes [for] $10,000. And the world gets confused, and sometimes the advertising confuses. [It's] all the other capabilities, of course, that [make the difference].

BYTE: ***What about the software side of the equation? Or are all the changes coming in hardware?***

Jonathan Titus *(see page 352)*: I would say, within 10 to 15 years, we're looking at tremendous advances in the amount of processing that people will have available on their desks. I am not sure, though, that they'll know exactly what to do with it.

Rich Malloy *(see page 288)*: I think the main changes we'll see are in terms of hardware—things getting much faster and smaller and cheaper. And then software will try to catch up to that, but there are problems.

continued



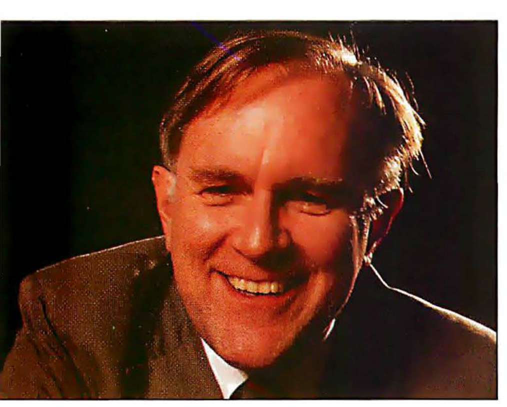
Paul G. Allen is chairman and president of *Asymetrix*, developer of Toolbox for Windows 3.0. In 1975, he cofounded Microsoft Corp. with Bill Gates and served as its executive vice president of research and new product development.



Stewart Alsop III is president of *Industry Publishing Company, Inc.*, and editor and publisher of *P.C. Letter*, a newsletter for executives in the personal computer industry.



Andreas Bechtolsheim is vice president of technology for *Sun Microsystems*, which he cofounded in 1982. He has been the principal designer of many Sun workstations, including the SPARCstation 1.



C. Gordon Bell is chief scientist at *Stardent Computer*, a company he cofounded. He is best known for the design and development of Digital Equipment Corp.'s VAX computer. He is also cofounder and director of The Computer Museum.

Brian Kernighan ***(see page 272)*****:** Software, unfortunately, is not nearly as easy to make go better as hardware seems to be.

Bob Frankston ***(see page 246)*****:** I think that tension [between hardware and software] is going to exist forever.

Brian Kernighan: It seems likely that the hardware is going to continue to get cheaper, so that you'll be able to get more and more power on your desk or whatever. And the software will not get better fast enough, and so you'll piddle away more and more of [the power] on stuff that doesn't quite work the way you want it to, or that doesn't quite work together.

Ken Olsen: [What] I think that people want in general computers is to have software applications that they can transport to anybody's computer. Any operating system, anybody's computer—transportable software. And they want, or should want if they've stopped analyzing, anybody's computer, anybody's operating system to work on a network around the world. And you come to the obvious conclusion that you want to write to standards, all the standards, and then the software plays in anybody's machine.

BYTE: ***How about networks—what do you see as their future? How will networking change the industry?***

Michael Slater: Networking, I think, will become standard in PCs, as it is standard in workstations today.

Paul Allen ***(see page 227)*****:** I think natural evolution in terms of business computing is that everybody's going to have a superpowerful network machine on their desk, maybe 15 years out.

Paul Carroll: There are some powerful trends going on now that will certainly continue, with emphasis on networking probably being the most important of those. I think that will facilitate the development of better electronic mail systems, which I happen to believe will be just awfully important. I think those will change the way I work and certainly will change the way a lot of other people work.

Terry Winograd ***(see page 366)*****:** What I see happening is the integration of what was good about the mainframes and what is good about the microcomputers, [and] what was good about the old systems was that they tied together people. Now with networking, you get the advantages you had from the stand-alone workstation, all the advantages of interaction you had, and now all the advantages of coordinating the information with a network. I think over the next five to 10 years, it will be odd to have a microcomputer in a work setting that isn't tied into a network. And, of course, we'll have other technology to tie into that—radio networks and cellular phone networks, etc.

Danny Hillis ***(see page 250)*****:** Well, I think initially it will be telephone networks and local area networks, and then those local area networks would one way or another be connected to a big network. So in some sense, the whole concept of the network will break down, and everything will be connected to everything in some software sense. So there will be everything from groups of computers connected together by telephone to things like the gigabyte network that Senator Gore is talking about. Either you'll be connected into it all, or you won't be connected into it at all.

Jonathan Titus: I think that major advances, from my point of view, over at least the next five years, are going to come in communications, and the ability for people to have one computer talk to another computer almost anywhere in the U.S., and perhaps in Western Europe, much the way our dial phones are set up now.

Bjarne Stroustrup: It doesn't mean networking with the next office. That's uninteresting. If I want something from [the guy in] the next office, I'll go in and talk to him. It's harder to have an argument with a guy in Stockholm—not much harder if you're networked properly. I think that's going to make changes in the way people use computers and the way people think about computers.

John Kemeny ***(see page 270)*****:** I still look forward to major progress in networking, and I think then we will have the best of all worlds—I mean, the advantages of timesharing and the advantages of personal computers coupled.

Brian Kernighan: More and more of these machines are being networked, but fundamentally, the P in PC is *personal*. That's the strength of the thing, but also the weakness. It's the strength because, by god, it's yours, do what you want with it, nobody else tells you what to do with it, and so on. But that's also the weakness. It's very hard to communicate with anybody else in any

A. BECHTOLSHEIM PHOTO: KASHI
C. GORDON BELL PHOTO: ARDENT COMP. CORP.

convenient way. And the kind of communication, sort of hopping around the machines, getting mail from people, and all these other things that I take for granted [on larger systems] are, I think, somewhat far away in the PC world as seen by most people.

Brit Hume *(see page 262)*: Well, it strikes me that what we have commonly thought of as microcomputers are becoming so powerful that they can be used as the core systems for networks that will be comparable to the systems that now run as minicomputers and mid-range systems. That's an obvious development that seems to have been coming for a long time.

BYTE: ***Speaking of minicomputers, how will the evolution of microcomputers affect minicomputers and mainframes?***

Andy Bechtolsheim *(see page 228)*: Basically, the next generation of [microcomputers] will have just about the same specs as the best mainframes you can get [today]. Of course, supercomputers are still faster. I mean, Cray, he gets another order of magnitude of power out of that. But in terms of the technology, it's reaching the mainframe level.

Tony Hoare *(see page 257)*: I think the microprocessor industry will come to dominate the whole of the computer industry. And, as it has done in the past 10 years, it will reproduce the evolutionary history of minicomputers and mainframes.

Bob Noyce: Well, the line I used to use is that the microcomputer is what the mainframe was 10 years ago. I think at this point in time the microcomputer is *becoming* a mainframe. Things are doubling every 1½ years, so I really can't use that first line anymore. Now I think the real question is, "Will the microcomputer be the top-of-the-line computer?" And I guess my real feeling is that it will be.

Bill Stallings *(see page 352)*: My guess would be the mainframe is not going to go away.

Tom McWilliams: Well, I think what we have been seeing is that the microcomputer used to be for fairly specialized applications. What has happened is that the power available on a microcomputer grows exponentially with time. As they have grown, they've overcome various classes of machines. Basically, today, they've replaced the minicomputers. I see the microcomputer becoming more and more dominant and taking over all computing except the largest machines'.

Terry Winograd: The problem with the mainframe was [that] integration was forced by the centralization adherent to the particular functionality of that mainframe. The idea was one of a central function where everybody played their pieces. Now we have a much more open-ended type of integration where we put the connections in where they count.

Wayne Ratliff *(see page 326)*: So I think the real computer substance lies in the personal computers. They're not the toys anymore. They're the thing. I probably can think of a lot of examples, but I guess I'm thinking mostly right now of when small mammals took over the world, and took the world away from the dinosaurs. I see the mainframes as being the dinosaurs. They're big. They are enormously powerful—massive, extensive. And here these little computers are like the small mammals, 60 million years ago or whatever. Although they are small, they are very facile in a variety of ways. They are small, cheap, [we] have lots of them, [and] they can stay alive at night.

BYTE: ***And how about the user interface? How do you think we will interact with computers in 10 or 15 years?***

Michael Slater: I think the character-mode applications will almost entirely go away, and everybody will make the transition into graphical user interface applications.

Charles Simonyi *(see page 340)*: The graphical user interface is a given; there is no doubt about it. It's a given today, and it will be stable for the foreseeable future.

David Evans *(see page 243)*: I think one of the curious things is that people have known that computing ought to be done interactively, and it ought to be graphics, and it ought to be on-line access. We've known that for at least 30 years, or maybe more than that. I think we'll see that kind of thing continuing. I think we'll see that better interfaces, and better human interfaces, and so forth, will continue to come on in the mass market at the bottom of the price [range].

Terry Winograd: We won't be using data gloves or anything like that. Rather than having a bunch of applications, we will

continued



James F. Blinn is associate director of project mathematics at Cal Tech. He is a pioneer in the fields of computer graphics and animation.



Gordon A. Campbell is founder, president, and CEO of *Chips & Technologies, Inc.*, which produces VLSI chip sets and firmware and provides design services to personal computer manufacturers. He is a 20-year veteran of the semiconductor business.



J. Rod Canion is cofounder, president, and CEO of *Compaq Computer Corp.*, where he has directed its operations and growth since 1982. Canion spent over 16 years in engineering and management at Texas Instruments.

Paul B. Carroll (not shown) is a technology reporter in the New York bureau of the *Wall Street Journal*. His main focus is covering IBM and other computer companies in the New York and Philadelphia areas.

have more of an integrated environment into an interface that lets me move smoothly into what I want to do, and it will organize what I want to do instead of organizing it by individual pieces of software. You won't have to get out of one environment to get into another thing.

Paul Allen: Graphical user interface options will be dominant here pretty quickly in the next few years. But I guess the big shift that I see is toward applications that work the way people think about solving their problems. Instead of a spreadsheet thinking about A1 + A2 or something like that, they will be dealing with higher-level content.

Philippe Kahn *(see page 269)*: I think that the next generation will [have] more direct communication and more direct use of personal computers and not [force] people to work the way the personal computer works, but rather have the personal computer work the way people work. That's very important.

Seymour Papert *(see page 325)*: I think the interface is part of a larger thing. I think that putting the emphasis on the interface somewhat confuses the issues. Clearly, having icons and a mouse, for many people, if not everybody, is a more comfortable interface than having to type in a lot of instructions in a mathematical form. I think that kind of direction opens computation to a lot more people, but if only the interface [is changed], and what lies behind it and what you can do with the system isn't changed, you're only scratching the surface. The interface is only the surface. I think we need deeper ways to think about differences in computation.

Bill Gates: There are a few discontinuities that are unclear when they'll come about and what their impact will be. [One of them is] so-called AI where the machine [has the] ability to move up in the reasoning chain beyond just "Here's a number; here's some text," to help you plan things, understand rules about your business. [AI is] one I'm optimistic about, but the track record the last 10 years is that not too much has gotten done. If you look at the business environment, just a natural evolution of the electronic-mail group-productivity tools should get us toward that vision.

David Evans: I still think the place that the micros and everything else are going to change is the human interface. Surely, they'll understand the spoken language.



The graphical user interface is a given; there is no doubt about it.

—Charles Simonyi

Esther Dyson *(see page 236)*: I think the eighties were the decade of direct manipulation, [and] I think the nineties are going to be about programmability. I don't want to sit and move stuff around on my screen all day and look at figures and have it recognize my gestures and listen to my voice. I want to tell it what to do and then go away; I don't want to babysit this computer. I want it to act *for* me, not *with* me.

BYTE: ***So, where does this take us? Can someone tie it all together?***

Jim Manzi: In terms of the next three, four, five years, we think one of the biggest wins is obviously tying in microcomputers or desktop computing into an organizational context. That will then extend, not just to the internal fabric of companies and organizations, but obviously to the external community as well, given things like ISDN and EDI, and things like that. But at the heart of it is going to be desktop computing, because that's where information is useful.

Grace Hopper *(see page 257)*: I think the microcomputers will continue to communicate. Actually, any company will have a very large system composed of computers. It will not be individual computers. There will be mainframes, minis, micros, and everything else all linked together, and the entire system will be what supports the company, not the individual pieces.

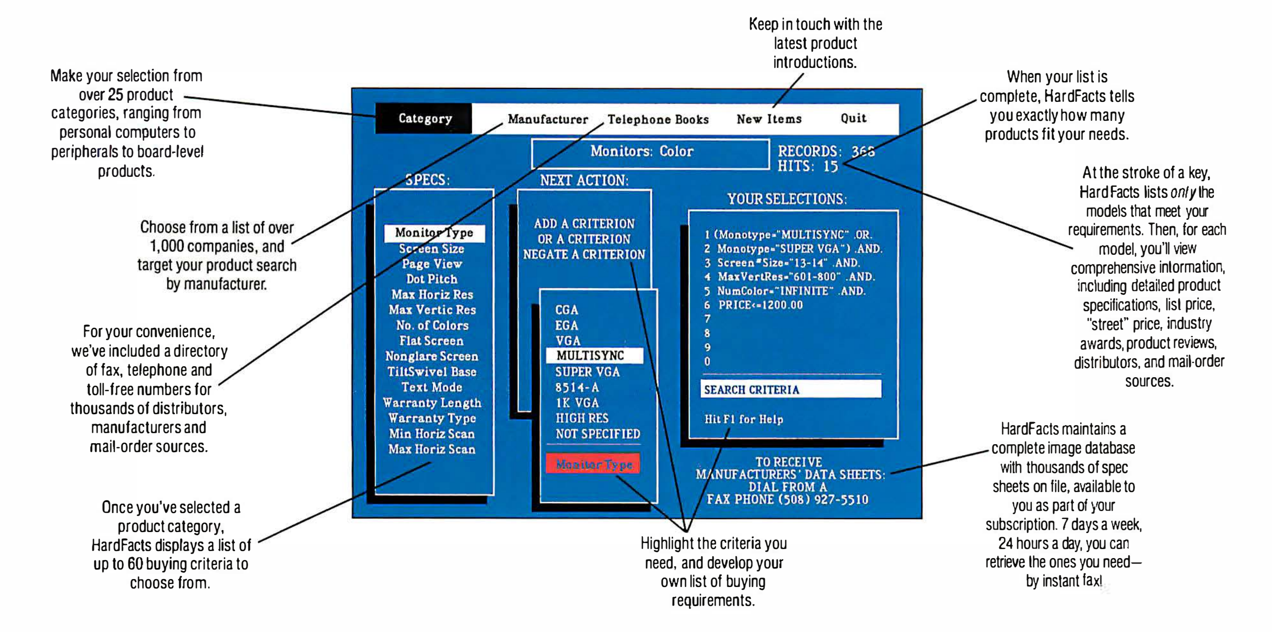
Jim Manzi: The big opportunity, I think, in computing generally, is to increase, in some sense, the information velocity, which is the speed with which information is moved, shared, accessed, used, and then shared again. Because information, all by itself, used by one person, is useless. So the whole concept of organization computing, or group computing, or network computing, starts and ends, in some sense, with an individual. ■

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Alan Kay:

On Computers in Education

I have worked with children over most of my career in Macintosh stuff. The PARC stuff that we did was originally designed for children. It works on adults because we have to think harder to design the stuff for children.

I don't think the technology is as big an issue [in education] as people's attitudes and values. Putting computers into schools is like [if] for some reason we thought our kids wouldn't succeed if they didn't become musicians [so] the state legislature decided to put pianos in every classroom. It's not going to help. Any musician will tell you that music is not in a piano. What I'm trying to say is, if you put computers in every school, it's like pianos in every school.

Everybody wants media and technology to save them, but it's attitudes, [and machines don't affect attitudes]. People think there is content in technology. And there isn't content except in what it makes us into. And that's something we have to decide. That's what our value system has to decide.

It doesn't require any money to have an attitude change. That's why it is so hard. We don't grow things, we fix them. So our idea about education is that children are defective adults—they have to be "fixed" in school—whereas more enlightened people like [Jean] Piaget and Jerome Brunner think of children as something you grow. They're all right the way they are. What we try to do is grow them in a certain direction. But there's nothing deficient about them. And the difference between those two attitudes is huge.

The way to save education is to get parents directly involved in the welfare of the children. That's the number-one thing. I've visited a lot of schools in the last 22 years, and the ones that have worked, 100 percent of them have had strong parent involvement. Because the thing about a school—a school is a lot of different kinds of things. Some schools are more regimented than others, but they all are kaleidoscopic. There's tons of stuff going on. It is extremely difficult for kids to actually consolidate any knowledge in the classroom. What happens at best is they are exposed to new ideas and different kinds of things. A consolidation, when it happens, happens at home. And it is *how* it happens, it's the attitude of their parents: if their parents are learners, if their parents are readers, if their parents come into the classroom.

I'm fully behind this thing that Iaccoca and the head of the National PTA are trying to do, which is besides having something like maternity leave, also get companies to give employees a half day a month off with pay if they go into their kid's school. You don't need all this [stuff]. You just need the parents to make sure the television is off for a reasonable amount of time, parent involvement, parents coming into the classroom, the parent obviously valuing what the life of the child is. And the children will respond every time.

When you have something like that, you can come in with the technology—you can come in with a piano, you can come in with a computer, and you can amplify the hell out of it because technology is just an amplifier. If you've got [junk], you're going to get [junk] amplified a millionfold.

Editor's note:
See biography, page 270.

Alvy Ray Smith:

On Software Patents

Patent issues. I think that's the number one problem. I think that's the most serious problem confronting the software industry in the next decade.

One of the things that I see holding us up is software patent issues, a monster that's raised its head in the past year or two. One of the things that the U.S. is blessed with, that's extremely creative, is a mass of brilliant software inventors. Suddenly, the patent office tried to start patenting software. It's a very large-bandwidth, creative system, and they're trying to just push it through the narrow bandwidth system of the patent office, which cannot possibly handle it. I'm very afraid that the patent issues are going to stifle the innovation we currently enjoy in the software industry. That's the number one problem facing us here. I think it would be a mistake to miss that very important issue.

The one that's on the top of my mind right now is the Pontel patent for patented airbrushes. What a trivial idea. Really trivial ideas are going to be patented. Those of us who sit around and wheel and deal in software are going to be completely restrained. That has to be solved in the next decade. I hope it gets solved immediately. All of this could come to a screeching halt if we don't get rid of this software patent issue.

Editor's note:
See biography, page 352.

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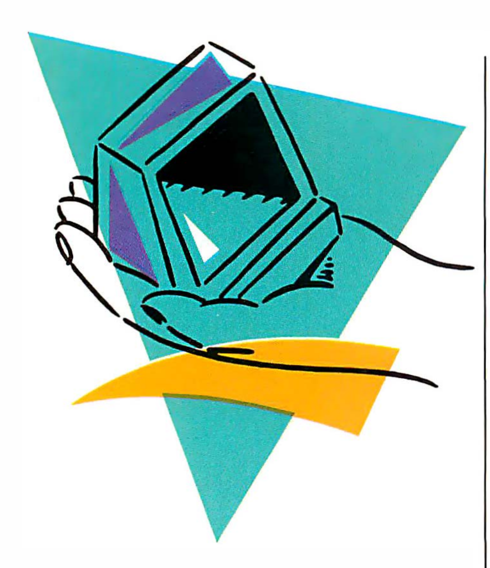
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THE BYTE SUMMIT

TOMORROW'S MACHINES

What do you think a typical microcomputer will look like in 10 or 15 years?



What does 1000 MIPS mean? It's kind of hard to wrap your head around it.

—Alvy Ray Smith

Bill Joy: Fifteen is pretty hard to say. Ten years—very powerful, multiprocessor, enormous amount of semiconductor memory, probably [will] not have a disk. Probably it will all be semiconductor, run on batteries, be portable, have a different metaphor than mouse/keyboard, probably involving voice, and you'll surely need a higher bandwidth output device, [and] vision—[you'll have] a very high-quality animated display.

Ryoichi Mori *(see biography, page 304)*: Ten or 15 years [from now], typical microcomputers will look like today's microcomputers. Here, "look like" means that the price and the size of most packages will be typically the same. The contents—that is, the scale of integration and the computing capability—will be improved 100 to 1000 times. Most of the improved capability will be consumed to provide better user interface. This means that microcomputers will have more "common sense"—that is, better database—and make better judgment using it. To support this, magnetic or optical storage devices will become smaller and smaller and will be built into the microcomputers more widely.

Jay Miner *(see page 296)*: I would suspect that the trends that we have seen in the past are going to continue—mainly, more miniaturization, more complexity, more function per dollar, more portability—since CMOS is getting much more sophisticated now, and most of the new big microprocessors are going CMOS, which allows them to be portable.

Andy Bechtolsheim: The workstations already are looking more and more the same as PCs—one or two disk drives and the floppy disk and some audio and slots. Obviously, we can assume that performance keeps doubling each year, and maybe we'll get to 1000 MIPS by the year 2000.

Alvy Ray Smith *(see page 352)*: It won't be too much of a stretch, say, that the desktops will be in the 1000-MIPS range by 2000. I don't think that's too hard to see at all. In fact, my numbers have it at 2000. What does it mean? What does 1000 MIPS mean? It's kind of hard to wrap your head around it.

Dick Shaffer: I'm convinced that we will have personal supercomputers. Not Crays; nobody gives a fig about Crays on your desktop. Let's just think what you could do if you had today's R6000 or today's MIPS machines or today's Silicon Graphics—$100,000 personal, graphics supercomputers—available for about $1000.

Gordon Bell: I think that [in 15 years,] things are going to structure out in these different strata. I think there'll be the $10 computer that is essentially the credit-card kind of thing. We could make a universal card that has all the information on it. That you'll see. The $100 dictating machine that basically is a memo-minder that you walk with. The $1000—I see the bulk of the machines are going to be those $1000 totally portable machines that you run around with, and that those go into a more central system. I think everybody's got to have the concept of a mainframe.

Gordon Campbell: I think you're still going to have base systems. I think people will gradually evolve to where they'll have a base system in their home and a base system in their office. And you will have any number of portable computers, whether they are palmtops, laptops, notebooks, whatever. We'll see a seamless exchange of data, some through hard wire, some through wireless LANs.

Stephen Wolfram *(see page 366)*: The most likely mechanism for connecting to peripheral devices would be some kind of an infrared-based thing. I mean, the whole idea of having wires and definite connectors is clearly not a particularly good one. If you have a sufficient bandwidth, the best thing to do is to have some kind of bar around your computer that emits infrared, and you plug devices onto it.

Paul Allen: Well, I think that the market will basically bifurcate. We're seeing some of it now. Portable computers are going to be like—something along the lines of the old Xerox Dynabook kind of concept where you've got a portable computer with a high-resolution screen that'll be in color. And you'll be able to input into that using either a keyboard or probably a stylus that can read handwriting or printing or whatever.

ILLUSTRATION: CATHARINE BENNETT

And I guess I see another kind of computer that's really your workhorse in a desktop computer that'll have a graphical user interface. That will be incredibly powerful, perhaps on the order of a Cray in terms of the power, and have a huge amount—gigabytes—of disk storage. Obviously, in an office environment, it's going to be on the network. There will also be multimedia capabilities integrated into that.

BYTE: ***Let's discuss the subject of portability. Do you think we'll have notebook computers or pocket computers? How do you think the size will evolve?***

Mitch Kapor: We're going to see the next generation in portability, things that are smaller than today's laptops: clipboard-size computers and shirt-pocket-size computers. The stylus-based interface is going to be very, very important for that class of devices because you can't have a keyboard, by definition.

Paul Carroll: I think it will be much smaller than it is now, maybe on the order of just a few pounds. I also think that it'll be better in all the normal ways: It'll be smaller, it'll be many times as fast, it'll have much better resolution, it'll have color, you'll be able to use a stylus to have it recognize your handwriting, do your data input that way if you like. I suspect that while these devices will be set up so I can pop one in my briefcase when I head on the road, there also will be a much larger screen on my desk to facilitate the handling of several tasks at once.

Bob Frankston: I find even [notebook computers] large; you want to be able to view it on your wrist, the Dick Tracy–type model, except [that] the reason for it—it's not so it'll be fancy—is you don't need any hands to view something on your wrist.

Gordon Bell: The computer will disappear by another 10 years in [its present form]. There will be zero-cost notebook-size computers with one chip in them that will have about 32 megabytes. So people will be carrying around these sort of minicellular, really connected, computers that go into their own databases somewhere.

Doug Engelbart ***(see page 236)*****:** Everyone's going to have a computer—carried around, or surgically implanted, or sitting on your hat or your spectacles or what—and they're all going to be connected into networks just totally, [and] those networks will be wireless.

Steve Leininger ***(see page 287)*****:** Well, to me, it would look an awful lot like one of these Day-Timer Seniors or day-runner seniors, basically an 8½ by 11 notebook with a low resolution. One would be 1024 by 768 color LCD. I think this unit will also have like a cellular phone capability: You'll have the voice capability on it, but you'll also have facsimile, you'll have storage. If someone called you, instead of your beeper going off, it'll be your notebook that'll go off. They'll quit being so much like computers, I think.

BYTE: ***This sounds more like a portable office than a portable computer. Do you really think cellular phones and faxes will enter the notebook arena?***

Dick Pick ***(see page 325)*****:** I think you'll see something that's integrated with the fax and the cellular phone, all in one small, couple-of-pound package. The way they're going, you're going to be down to where it's going to be smaller than a notebook, and it's going to have a fax machine, and a cellular phone, and the whole thing is going to be wrapped up into one unit. You just pick it up and use it.

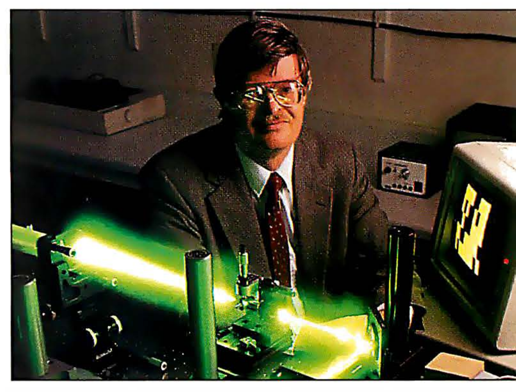
Gordon Campbell: We probably will see things like cellular telephone migrate in, so that we can receive voice-mail and fax capabilities in notebook-style computers as well. And I think people will rely upon the portable computer as a way to stay in touch. The flaw in the cellular phone is that it really doesn't effectively take voice-mail messages or faxes yet. I think that the notebook and cellular marriage will solve a lot of that problem.

Steve Leininger: I think you are going to see a lot more of it having to do with your telephone. Perhaps you'll have a combination telephone, facsimile, computer database. It'll sort of be your personal manager. And it'll definitely be small enough to carry around with you.

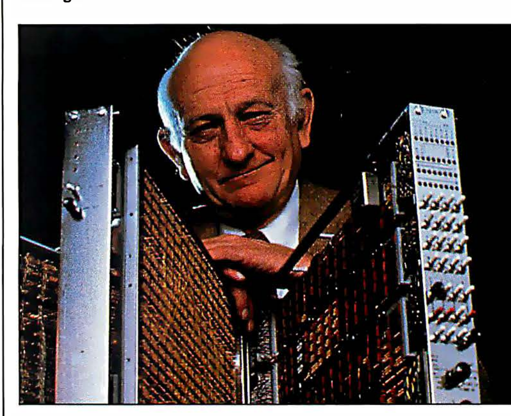
Rod Canion ***(see page 230)*****:** In addition to [getting smaller and smaller], of course, you have all the other technologies like voice recognition and artificial intelligence, the evolution of cellular communications. We will have resources that we can call upon at any time through natural voice communications, access to data around the world (perhaps around the solar system at that time).

Bill Gates: That's a little radical. I don't

continued



H. John Caulfield is director of the *Center for Applied Optics* and research professor of both optical engineering and optical science at The University of Alabama in Huntsville. He is an authority on optical computing and holographic storage.

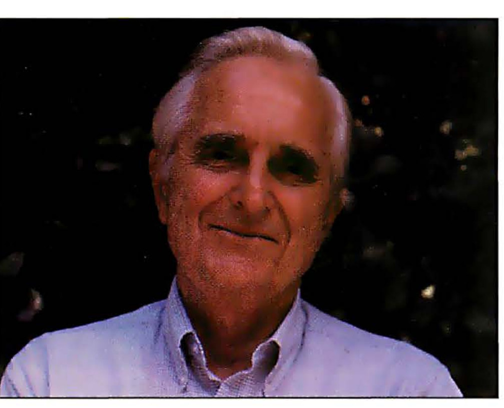


John Cocke is an *IBM* Fellow and a pioneer in the fields of computer architecture and optimizing compilers. He was instrumental in the conception, design, and implementation of the first RISC computer and is responsible for such architectural innovations as "look-ahead" virtual memory and instruction pipelining. Cocke is a recipient of the A. M. Turing award from the ACM.

H. J. CAULFIELD PHOTO: ROB NELSON



Esther Dyson is editor and publisher of *Release 1.0*, a monthly newsletter for the personal computer industry, and president of *EDventure Holdings*, which also produces the Annual PC Forum. In October, EDventure will produce the inaugural East-West High-Tech Forum in Budapest, Hungary.



Douglas Engelbart is the director of the Bootstrap Project at *Stanford University*. He developed the NLS, one of the first microcomputers, in the 1960s. He is also known for his pioneering work in augmentation and in groupware.

think it's necessary. If you can connect up every few hours, that's good enough. The machine in the office will just have this optic fiber that will go off to the world network out there. It will directly connect to some kind of server and will have a lot of storage.

Nicholas Negroponte ***(see page 304)*****:** There will be a family of physical products that will range from things the size of your wallet or a cellular telephone to real bona fide laptops to desktops. And they're going to start intercommunicating with each other in ways that are really very, very different than what we currently do or have now. I think there will be much more intercommunication between desktop computer—microelectronics—and your inside pocket or your pocketbook or your wrist.

Bob Frankston: We already have phones now that are ornery—I wouldn't quite call them intelligent but definitely ornery—but we'll be able to [link] into the telecommunications, a combination of—simple ISDN—smarter systems. You'll be able to teach your phone how to find you, whether to find you, and [how to] handle things more intelligently.

Doug Engelbart: Everybody remotely associated with communicating with other people will have something to carry around with them. The size will be limited to what kind of display and input stuff that you want.

Lee Felsenstein: One of the things that I'm looking toward, what we're developing here, will amount to a desk that you can hang on your belt. I look forward to that kind of product proliferating in various forms. I'm trying to make it an open architecture design.

John Markoff ***(see page 292)*****:** Right now most people have desktop computers as their principal computers, and they have a laptop as a secondary computer. And I think that all the innovation is going to be taking place in the smaller packages. We're all still trying to build a Dynabook basically. This is Alan Kay's vision of the early 1970s, and we're going to get progressively closer to it.

Alan Kay ***(see page 270)*****:** [There were] three physical forms we thought up for the Dynabook in 1968. One of them was the very slim notebook, weighing around 2 pounds or so. That's the thing that most people picture it as. And that's the one I made a cardboard model of. The second one was a head-mounted display; [we] thought it would be dandy for airplanes. And the third thing was [the] wristwatch idea, which is where networking gets really pervasive. Just as we would be surprised to walk into a room [today] without an electric outlet, at some point in the future, we'll be surprised to walk into a room that doesn't have a transponder in it, a cellular transponder type of thing.

Mitch Kapor: I think [the typical microcomputer is] going to look pretty much like the ones today, except that there are going to be new form factors like palmtop computers, desktop supercomputers, and there will be a lot more embedded microprocessors in things.

BYTE: ***That raises another point. Will the typical microcomputer be a box of any sort, or will it be hidden?***

Nicholas Negroponte: First of all, they will be buried, for the most part, inside other things, so there won't be a typical microcomputer, as such. It'll be part of something else.

Rich Malloy: Probably, we won't see it. It will be hidden someplace, either inside a monitor or inside some other device, maybe inside a keyboard. And it'll probably be hidden in a lot of objects. Practically every electrical object will have some kind of microprocessor controlling it, maybe even as small as inside a pen.

Gary Kildall ***(see page 282)*****:** Well, I think that a lot of the future we are going to see [with] microprocessors is probably pretty much the same way it started originally—that's oriented toward a lot of embedded microprocessors and devices that we use in everyday life. More functionality at a lower cost, in everything from communications to multimedia and in general.

Jonathan Sachs ***(see page 336)*****:** As computers get cheaper and cheaper and more and more powerful, I think we're going to see more and more special-purpose systems. We're going to see more and more computers incorporated into other products (either visibly or invisibly). It's already happening—computers have even been incorporated in computers. I think we'll see a lot more very targeted hardware/software turnkey solutions.

Seymour Papert: What I hope is that

continued

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sometime, maybe 15 or 20 years—maybe 10 or 15 years is too soon—sometime we won't even talk about the computer. It will dissolve away into the environment or world we live in.

Tony Hoare: There will be no such thing as a typical microcomputer, and for certain embedded applications, microcomputers will become more and more application-oriented and specialized. For general applications, they will surely come to look like and play the role of minicomputers, mainframes, and even supercomputers. The most numerous, of course, will be the application-oriented embedded systems.

BYTE: ***And what do you think the typical microcomputer will be able to do in 10 or 15 years?***


t this point in time the microcomputer is becoming a mainframe.

—Bob Noyce

Jim Blinn ***(see page 229)*****:** Well, I don't think computers have done anything new for the last 20 years. They've just done the same sorts of things, only cheaper and faster. I'm not sure of that. Maybe the multimedia craze with CD players and whatnot will do something substantially different. But in some sense, that's always been doable. It just hasn't been doable on a widespread cheap range.

Charles Simonyi: The differences will probably be in a better use of multimedia on the machine—in CD-ROM and other optical memories providing sufficient storage and then having very efficient standard algorithms to encode audio and video information. The other capability I think will be important [is] stylus control, initially developed for handwriting input, [but giving] rise to an even more efficient shorthand way of communicating with the computer.

Brit Hume: It's easy to [see] a small kernel running in memory that would be able to conduct searches of CD-ROM databases that contain encyclopedias and, of course, the things we already have, dictionaries and thesauruses and so on, dictionaries of quotations.

Paul Carroll: It seems to me that video text will take off in some form and at the least will mean that people more and more will rely on electronic media to get the breaking news. Many, many more databases will become accessible to people, and you'll get all kinds of encyclopedias on-line. You'll get far more types of publications on-line.

Danny Hillis: I think [the] emphasis will be on the human interaction part and on talking to the network, so that it becomes your interface—the network. But an awful lot of the real data and the real computing will, in fact, be done remotely when you have big problems.

continued

Stewart Alsop: [We need] new network operating systems. I think the ones we've got are wrong. [They] don't optimize human interaction in a workgroup; instead they're optimizing the computer-to-computer [interaction]. And we're going to get something of a revolution from users in that respect. They're going to rebel. I can't find any other solution to the problem.

Lee Felsenstein: Well, the most significant thing [the microcomputer] will be able to do is communicate with others of its kind and over a broad range.

John Warnock *(see page 354)*: I think technology has a tendency to be exponential in its growth rather than linear, so I would see computers used primarily as very, very effective communication tools—aids for helping people communicate.

Bill Gates: On that screen, based on how you've customized it, will be the scheduling, sales, budget, project, news—the information that would interest you. As you click in on that information, it will show you more detail, what's going on. You can combine that information in new ways and communicate with people. It will be your fundamental tool for knowing what's happening.

Paul Carroll: It'll also be connected much better to lots of other things, to your telephone, to a laser printer. A laser printer will become a copier, which will become a scanner, which will become a fax. All those distinctions will disappear, and there will be local connections between my PC and a device like that either on my desk or not very far away from me.

Lee Felsenstein: What I expect is that various types of desk work will be made available to the user without requiring that the user be at a desk. People who have functions that take them into the actual operations of the enterprise will now be able to handle portions of the desk work. And the separation between paperwork and "real work" will blur and begin to diminish.

Mitch Kapor: When you can start carrying around a computing environment with you everywhere you go, it will let people stay in constant contact. I think that in that context, the digital cellular developments in the mid-nineties will be very important, because you'll be able to have a reliable, wireless data link from a remote device to anywhere else. These will not only be "go everywhere" devices, but they'll be "always in contact" devices.

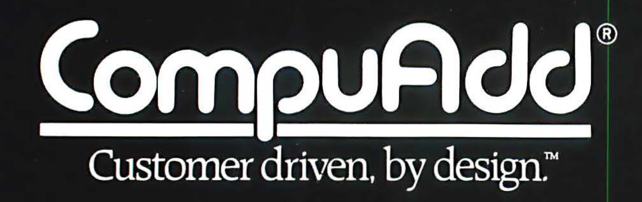
BYTE: ***It certainly sounds like tomorrow's machines are going to be fantastic.***

Rod Canion: I think if you extrapolate some of the technical trends, what you'll see is incredible computing performance, storage capacity, and all the resources we need in a very, very small package: the wristwatch supercomputer. I always think that you can only talk about the next five years. If you're going to go out 10 to 15 years, you really have to go beyond just about the most incredible science fiction that you've ever imagined to see what we're really going to be doing with microcomputers. ■

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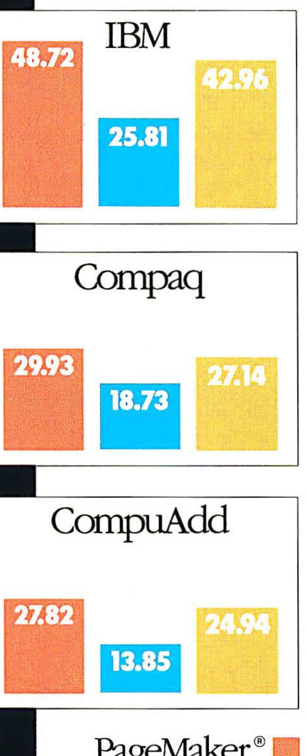
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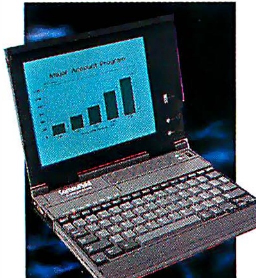
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Alan Kay:

On the Next Revolution

I think of the computer as being an event like the invention of writing, long, long ago. Some of the significant things that happened in the history of writing are similar to some of the significant things that have happened in the last 40 years [with computers]. We're sort of compressing 40,000 years into 40 here.

I think the first revolution in writing was getting it off the wall and into books. The first revolution in computing was getting out of batch processing and into timesharing. So, you have a nice analogy there. If you look at the pictures of the old libraries, they didn't have shelves because the big town library would only have maybe 25 books or so, and each one would have its own table. It looked a lot like a timesharing bull pen to me. So, I think of this first phase—this first computer revolution—as being institutional timesharing, where the institution still has to own all the equipment, and you have to intercede with them in order to get access, and so forth.

The second revolution in printing—Gutenberg—made books that were possible for an individual to own, but [that] imitated the old manuscript, like a personal computer today looks like an old timesharing terminal. As McLuhan pointed out, every time you create a new medium, it takes its initial content from the old. So you have these lags. The initial content on the microcomputer was the same content as the timesharing. MS-DOS is really an extension of the timesharing wave.

To me, the second computer revolution is not just the computer on the desktop, but the Macintosh/Xerox PARC way of doing [the] user interface. And there, the big transition was in going from a user interface (in the timesharing system and on the MS-DOS machines) that is mainly thought of as access to function.

What the Mac did was to redefine the relationship of the user in a couple of important ways. One is [that] instead of its main job being access to function, the main job of the Mac is to be a learning environment. Its main job is awareness, not access, not control. So, the idea is, whatever task you have, you should learn about 70 percent of all there is to know by being driven by any particular task, and you can transfer [that knowledge] from application to application. And that works out well enough to constitute a revolution such that even IBM is interested in doing it.

The third revolution that is going to come is one that is driven by networking—it's a pervasive technology—and I call [it] the intimate revolution.

Tools and Agents

Another way to think about the Mac [interface] is that it is tool-based. At PARC, we had an impulse to try and bring the computer into human scale. Anything that is larger than human scale—it could be a sports figure—we treat religiously. It's not even a joke. It's actually the way our nervous system works.

So, one of the first things you have to do is to bring things into human scale, and the two human-level ways we have [had] of extending ourselves over the last several hundred thousand years is by tools—both physical and mental tools—and by agenting. Agenting is where you get somebody else to do your goals for you.

I've heard pointed out that for most of human history, most machines that humans have constructed have had other humans as moving parts. So we build society and so forth. We build these organizations that have fewer goals than the number of parts in them. And we are a species that is interested in getting our goals cloned, and we are also willing to have goals cloned into us. If we weren't, we'd be bumblebees.

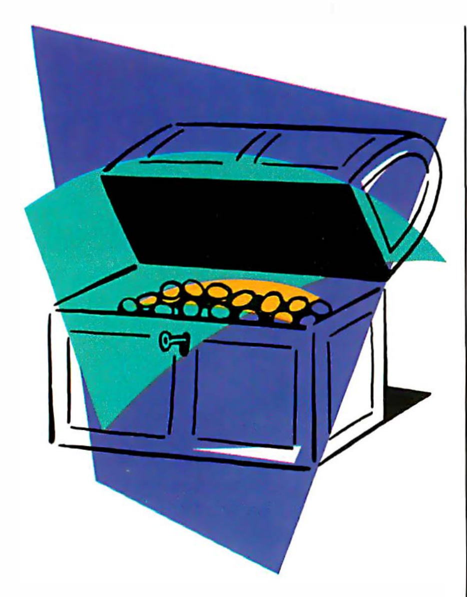
So, the two ways of getting something into human scale are by making it into something like a tool or making it into something like an agent. The thing we decided to do at PARC was to make the machine be like a tool. That's where all the icons [came from]. So, a tool is something that you look at and manipulate. Manipulation is a very important part. An agent is something that looks at you, [something] you manage.

The belief that some of us have is that this third computer revolution, the way I think of it, is driven by networking. Computers without on/off switches: Like a wristwatch, they'll be too useful. You won't want to turn them [off] because you'll be using them for such trivial things, as well as important things, that you won't want to wait for them to fire up, and stuff like that. The user interface, unlike the Mac, will be not tool-based, but agent-based.

And the thing that is going to drive the interface to be agent-based is [this] problem: In 10 years, we will be hooked up to more than a trillion objects of useful knowledge, and no direct manipulation interface can handle that. People are not going to sit down with a super SQL application and start fishing around the entire world for things that might be of use to them. Instead, [the interfaces] are going to be 24-hour retrievers that are constantly firing away doing things.

At some level, as you want [agents] to take on more and more complex goals, you'll want them to be more and more in our context, more and more flexible, more and more intelligent. But just the ability to be able to defer things like access goals [is significant]—like an agent that would tell you if amongst your 100 pending E-mail [messages], that there is one that is really important, [that would] notice words like "meeting" and "canceled."

Editor's note:
See biography, page 270.



Innovating is easy: You just rub smart people and money together.

—Alan Kay

THE BYTE SUMMIT

NEW OPPORTUNITIES

If you were going to start a new company now, what market area would you aim at?

Lee Felsenstein: First of all, I would advise anybody, find out what everyone says won't sell and do that. Because the primary feature that I have discovered in terms of the marketing product-development function is basically a hysterical aversion to innovation and a desire to play it safe by designing or creating that which has already been created. When you get into production, that's another matter. As Ted Nelson has so aptly said, everyone wants to be second. So, that's my major tip. Do what everybody else won't do, especially when there is no good reason.

John Caulfield: *(see biography, page 235)*: I would aim at niches first of all. I am not ashamed of that word. I think all computers are now a niche technology. The time of the general-purpose computer that IBM had is gone. Microcomputers destroyed it. Basically, your miniprocessors did. There's a supercomputer niche, innumerable microcomputer niches; there are multiprocessor niches.

Ken Olsen: You have to adjust to the world. And if you are starting a company, you always have to be reminded that there are some things a small company can do better, and there are some things only a big company can do. And a big company that's going to go out and compete with a small company on things that [the small company] can do better always loses. When it comes to specialized applications, they are done by a small company that is expert in something. And a big company cannot be that expert in everything.

Dick Pick: It may not be the most glamorous, but the people that are going to be successful in computing, and make livings off of computing, are people that are going to identify [a vertical market] and know more about that field than the people out there, and [who] can take it to the [emergence] of the computing technology, the data management technology, the communications, the various stuff, and be able to provide solutions.

BYTE: ***But what specific areas do you think will be big winners?***

Bill Gates: There are opportunities in multimedia [and] artificial intelligence. I wouldn't start one to do another word processor—that's a tough business to try to enter into. I still wouldn't do a hardware company, but that's probably just my match of skills. There's a lot in software, and hopefully people will take us established guys and, to some degree, blow us away.

Jerry Pournelle: That's no secret, I've said it many times—multimedia. Gates is absolutely right.

Gordon Campbell: Multimedia. While I think we're probably still a number of years away from its becoming a reality, I think as we can migrate real-time video into the PC, we have a tremendous tool for education. People have adjusted pretty effectively to television over the last 20 to 30 years. I think the migration of real-time video into PCs is going to be a real godsend.

Alan Kay: This is the biggest trap in multimedia. Most people think that by taking something and making images out of it, you can bypass what people aren't getting from books. But that's, in fact, not true. Images beg to be recognized, and words beg to be understood.

Paul Carroll: I don't see multimedia as a market, but I do see it as a very important technology that will facilitate more work in desktop presentations and corporate training, [and] better teaching in universities, high schools, and grade schools.

Gordon Campbell: I'd like to see the multimedia time frame moved out, and the primary reason for that is that I think it will ultimately be by far the most effective educational vehicle that we can have. If there is a vehicle that would allow us to effectively combine with [TV]—a lot of what kids like to do is just watch TV—and make it a strong educational tool, I think it would help the U.S. quite a lot.

Jim Blinn: What I think would be interesting to do is maybe something to do with multimedia, or something to do with video production. I do that [now] because I'm interested in it, and doing it as a company might be only slightly different from what I'm doing now—produce videotape, pro-

ILLUSTRATION: CATHARINE BENNETT

duce educational videotapes for the high school mathematics-level education.

Stewart Alsop: I believe in the area of multimedia, and a number of component technologies need to happen. I think video compression is a really important technology. I think that every computer needs to have compression built into it. I believe in multimedia enough that I think every computer should come equipped with both a camera and a microphone.

Jonathan Sachs: Well, I guess I see [multimedia] as the next fad. I'm not sure I feel it's the next serious thing. I'm not even sure I know what it means. To the extent that it means being able to make up audiovisual slide shows that are interactive and things like that, yes, there's a market for it, but it's a fairly narrow thing. I think it's something that's invented by Apple after they've sort of conquered the desktop publishing market to say, OK, here is the next great thing that we're going to conquer.

Ted Nelson ***(see page 304)*****:** Well, desktop movie-making is going to be awfully big. And the RenderMan standard, this is already beginning on the Amiga. My understanding is, for example, that Disney Productions now models on the Amiga and renders on bigger machines, so that the same capabilities that Hollywood's most sophisticated production organizations have [are] now coming into the hands of the people. And that will be the democratization of visualization. This is a great step forward.

Terry Winograd: Multimedia is finally going to come into its place. It will become much more a central part of computers.

Charles Simonyi: It is no longer programmers making doodles on pieces of paper. It is almost an issue of individual arts to exploit the multimedia capabilities.

John Markoff: I'm intrigued by multimedia, although I think it's probably a decade [away from being] mainstream. The tools are just nowhere near good enough to permit people to use them as easily as they use tools like word processors. They just have to put a lot more power and control into that class of tool.

Gordon Campbell: I think in addition to that, we are going to need to have, from a software perspective, some efficient ways to manage the databases that become available as we can actually migrate video and vast—and when I say vast, I'm talking about more than just encyclopedias and dictionaries—[amounts of information] into the CD-realm form factor.

Stewart Alsop: Multimedia literature. What I mean is not just programming, but a combination of programming and editorial development to create products that engage the intellectual and emotional capacities that we have as human beings, but they'll run on computers. People in the computer business think of data as data. It's this lifeless thing that you cram onto a CD-ROM and sell to people for $1000. But there's something else you do to the data, called editing, [that] creates an experience for the customer. And it's that experience that you're selling. That's different [from] data.

Nicholas Negroponte: Now, on the same list of things that are going to be big wins is flat-panel display technology. Over the next 10 years, that will be a very, very substantial field. The CRT, in spite of what people think, has locked us into a definition of what resolution should be. I think this will change very substantially.

BYTE: ***What opportunities does anyone else foresee in the area of display technology?***

Steve Leininger: Color, flat-panel displays—portable, high-resolution, high-information-content displays.

Charles Simonyi: Displays will have better resolution; they will be perfectly flat.

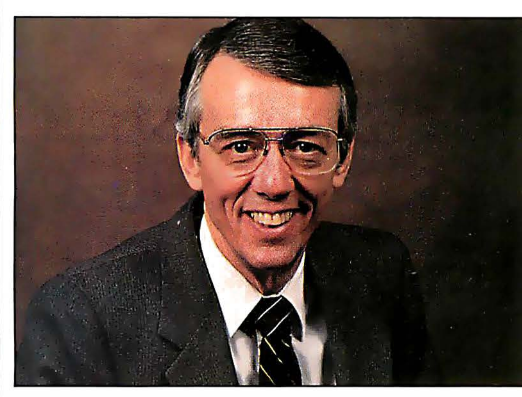
Michael Slater: Display resolution, I think, will go up. Today, everyone is used to 640 by 480 in the PC world, and roughly 1280 by 1000 or 1000 by 800 in the workstation world. I think you'll see the PC world moving up to the workstation-level resolution.

Gordon Bell: We'll all be sitting with big screens, big color screens. I don't know whether it's as big as a 45-inch screen or not, but that will be the interaction mode.

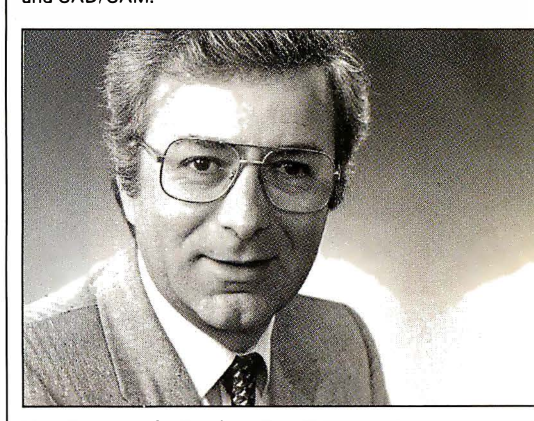
Bill Gates: The ability to get a very large screen and see a lot of information on it—people underestimate the impact of that. We will be flat-panel by then, and a lot of people will have their entire desktop or white-board-type areas be computer displays.

Michael Slater: I think all the flat-paneled display technologies are important. The

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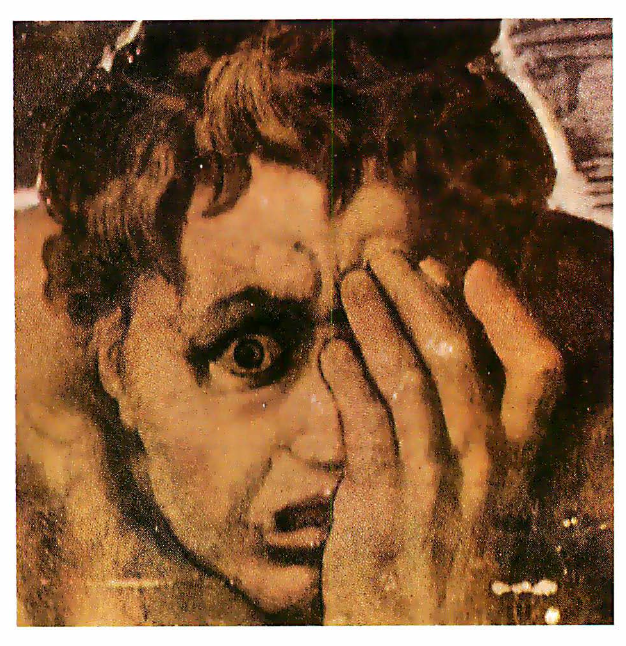


David C. Evans is cofounder, chairman, president, and CEO of *Evans & Sutherland Computer Corp.* His major contributions in computers have been in interactive computing, graphics, and CAD/CAM.



Federico Faggin is cofounder and president of *Synaptics, Inc.*, which is dedicated to the creation of hardware for neural networks and other machine intelligence applications. He conceived, designed, or codesigned many of the earliest microprocessors, including the 8008 and 8080 for Intel, and the Z80 for Zilog, a company that he cofounded.

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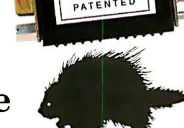
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active-matrix LCD technology that is now in the early stages of being a commercial technology has a reasonable chance to become a dominant technology for computer displays.

Lee Felsenstein: "Thick-film," active-matrix liquid-crystal displays. It's using a different technology; it's using cadmium sulfide and cadmium cyanide, which engineers will recognize as being common materials in photocells and stuff like that. [The interesting thing is] that if two people had walked down the hall at Bell Labs in 1947, we would not be using silicon for transistors. We'd be using these materials, because there was development going on in cadmium sulfide and [cadmium] cyanide in one office, and in the other office, they were doing the point-contact transistor.

David Evans: Everybody would like a high-resolution, flat-display device, bright enough and rich enough and cheap enough. We limit ourselves to seeing very crude representations of things. That's one domain where I think we know that there's a real need for something better. I think that HD television will probably produce the technology that we'll enjoy, for example.

John Markoff: The most important step is going to be in display technology, I think, in a lot of ways. HDTV, there's the real question: There's this collision coming between the television makers and the computer makers, and I'm not sure who's going to come out alive, but I think [it] will be who innovates best.

Seymour Papert: We need to break down the barriers between television and the computer. You know, when we started out, we used to use the television as a monitor, and I think we'll go back to this, in a sense. I have an idea that eventually the computer will be more flexible. I would like to see a "softer" computer that doesn't respond in such a "hard-edged" way. I'd like computers to have more common sense. I don't know which technologies will dominate, but the solution will be related to understanding—how to think about thinking. We'll do it by understanding people better [instead of] by using new technology—it's a product of ideas rather than technology.

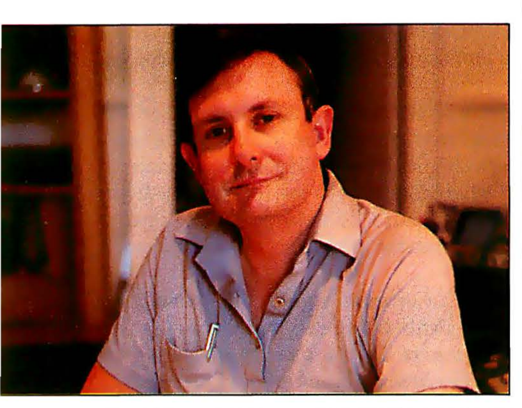
John Warnock: I would like to see the standards in television increase. The technology that I would like to see in place to enable everything in the future is the higher-bandwidth communication, because that's starting to become a limiting factor.

BYTE: ***Communications and its many related fields have been pretty active in the recent past. Do you think there are opportunities in these areas in the future?***

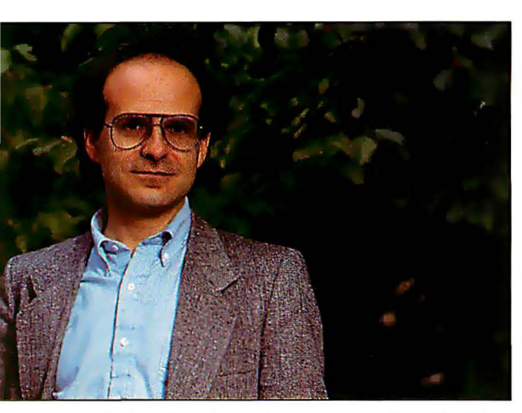
Jonathan Titus: I think there's a lot to be done in terms of communications software. And it just seems to me that that would be the place that I would look. That market seems to be pretty well fragmented between people [who] are offering bits and pieces of the solution but nothing really that ties everything together.

Bob Noyce: Well, I think [the key is] distributed memory—shared memory. I think

continued



Lee Felsenstein is president and chief engineer for *Golemics, Inc.*, a microcomputer hardware R&D company. He designed the first video display adapter for the S-100 bus as well as the Osborne-1, the first portable computer.



Robert Frankston is coinventor of the first electronic spreadsheet, VisiCalc. He is currently employed by *Lotus Development Corp.*

it's breaking down the problems and parceling them out like you do in a company. Maybe we may organize our computing as we do a company—with managers, etc., and a hierarchy. We don't know how to manage distributed processing.

Niklaus Wirth: I have no intention to start a company, but the interesting, the challenging field is that of distributed systems and parallel processing. That is what will be a likely field; whether it is commercially that viable, I don't know. But it's certainly, from the conceptual point of view, the challenge.

Jim Manzi: Also, distributed computing applications. Distributed applications that make network usage as integrated as desktop usage will be in the next year or two. Running an object-oriented network operating environment, a graphical environment, across a network where a user can access anything, and do anything right from his or her desktop with the least amount of pain and frustration.

Bill Stallings: I think you'll go more to distributed processing as the applications get solidified. That's a big area of work in ISO—developing distributed applications with recovery and things like distributed transaction processing. I think a lot of that will be distributed.

Bill Joy: I think the exciting area in the nineties is going to be writing, developing interesting systems, distributed systems, to automate and to make more productive groups of people. And I think getting involved with writing end-user applications and developing those kinds of systems would be very exciting.

Terry Winograd: I guess it would be systems for design of integrated work settings, something with user customizability, group customizability. People are beginning to use computers much more that way.

Doug Engelbart: I think the big market opening is in groupware—it hasn't even begun to be really tapped. That's what's really going to cause so much new alignment in markets and products in order for things to work inside organizations, between people. That's the big challenge.

Stewart Alsop: I also believe in groupware very strongly. I hate the term *groupware*, because it suggests all kinds of AI-type stuff. I prefer to call it network applications.

Terry Winograd: Networking is important, and anything having to do with networking has to come.

Michael Slater: I think bringing networking into something that companies can do without having to go through a great deal of pain, and having to have somebody devoted to maintaining the network, is a real important growth area.

Stewart Alsop: [The appropriate network model] includes the notion of ad hoc use of network resources instead of this tightly controlled centralized use of network resources. There's a very PC-like future for network computing, which is that you can install your own applications, that you can mix and match on the network, and share stuff without having to get official approval.

John Warnock: Standards in the communications business are extremely important. People say that standards stifle innovation, and in communications that's not true. Standards enable communications.

Terry Winograd: If I were to define something in the hardware line, I guess it would be in portable computing and networking.

Andy Bechtolsheim: I think you're going to get 486s in laptops probably this year or next year—and there's going to be very little difference between laptops and desktop machines in the near future.

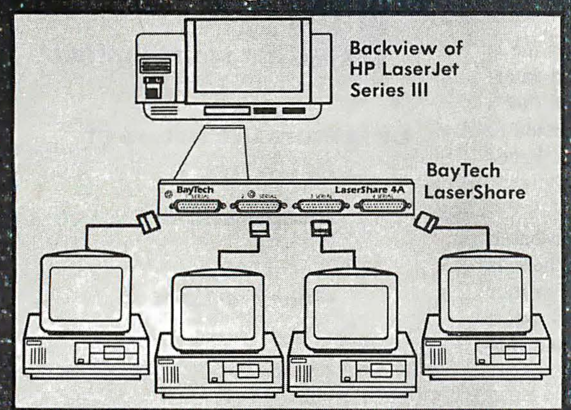
Brit Hume: If I were going to start a company, I would try to develop some applications for laptop computers. My idea would be that I would try to reverse the process in terms of the growth of programs' current size. For example, I would see a real market for a scaled-down version of a program like Procomm. And it is my view that you could get a program that would be about 80K. I think there's a market out there because the laptop market is growing.

Gordon Campbell: I think there will be a tremendous number of opportunities still in the PC arena as we migrate into these different areas. So the communication aspect of portables, I think, will still be a strong market—one of the most difficult markets.

Bob Frankston: What we're limited by is more the failure of imagination, people who don't understand why we need gigabytes of communication capacity per person.

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Alan Kay: Communications services are what the nineties are all about. In the future, we don't want to think of [the computer] as what we think of it now. We have to think of it as something like clothing. We have to think of it as something like a communications device. That will tell us a lot more about what the thing should be, rather than thinking of it as something that is going to do desktop publishing better.

BYTE: *Are there any other opportunities for new companies out there?*

Danny Hillis: I guess I think the big market need today is making computers simpler to use. And in reducing the complexity of interacting with [them].

Tony Hoare: I am quite convinced that the central question is how to make computers more usable, how to make their software more comprehensible, and how to avoid the dangers imposed by the complexities of standard software in the current generation.

Rod Canion: The ability to interact with the computer will get better and better because of things like multimedia and artificial intelligence that are all just right on the horizon here.

Mitch Kapor: [One] of the most interesting things, for instance, is this whole area of virtual reality. The notion of creating an interactive 3-D computer graphics simulation of some environment, whether real or imaginary, that you participate in—not simply by looking at a screen and moving around a mouse, but by basically wearing some special clothing, some goggles, and a data glove.

Rich Malloy: I think that the most interesting area right now is where you take input that has been very hard for a computer to recognize—for example, handwriting, voice recognition. What looks very interesting is neural-network technology and that kind of thing. I would look into that area, try to develop products that could allow us as humans to interact better and more efficiently with computers.

Bill Joy: Figuring out new ways of interacting with the user. The really great applications invent new metaphors in each application domain. That is going to be really exciting.

Mitch Kapor: I think [desktop virtual reality] will give rise to new metaphors for computing—the cyberspace metaphor as opposed to the desktop metaphor.

Bill Stallings: One area that strikes me is going more toward human-oriented interfaces. For example, there's an area that's almost nonexistent now but is projected to grow very dramatically: hand-held, handwritten systems.

Philippe Kahn: I'm sure that pen-based computing is important, because there is going to be a lot of [it]. Within three or four years, at least in a very commercial use, a lot of people will be using pen-based machines to actually do a lot of things.

Dick Shaffer: At the moment, I think stylus systems is a hot area. Somewhere in two to five years, I think that a major company will be started in that field. Commercialize what you can do in handwriting recognition today.

Paul Carroll: I've also become intrigued by these handwriting-recognition systems. I don't think those will have much of an impact over the next few years, anyway, but I think that within three, four, five years, maybe a little bit longer, those will open up whole new markets.

Bill Joy: The problem we really have is not printing, but handwriting input, voice input, and some of these things that require massive amounts of computation. I'm not sure even extrapolated parallel RISC machines are going to have enough power to recognize most people's handwriting.

Paul Carroll: If I could commercialize something on the drawing board, it would be the ability to interpret all kinds of writing, not just block printing but cursive writing and so forth.

Bill Stallings: Handwritten input, voice input, human input as opposed to keyboard/mouse input—I think that's going to really broaden the base of where things are used.

Ken Sakamura ***(see page 336)*****:** Keyboards [are] already good enough for most Americans. Japanese people have no experience with keyboards, and in order to get good widespread use of computers, we need an input method that people feel comfortable with. So there's a tremendous incentive for Japanese companies to develop good handwriting-recognition technology.

Federico Faggin ***(see page 243)*****:** [If] you have to read the unconstrained handwriting of a person writing about a subject that you don't even know about—there the information is mostly in the context, and so you get a lot of clues as to how to interpret handwriting that way—that is an extremely complex task. There, neural networks will be very helpful.



What we're limited by is more the failure of imagination.

—Bob Frankston

Jay Miner: Handwriting—I don't see that. I think voice is much more important.

Nicholas Negroponte: I'd put speech I/O very much at the top of the list because I think that the primary means of communication with computers in the next millennium will be speech.

Jay Miner: Voice recognition is coming, I'm sure. It's not here yet. But as the chips get denser and more efficient and smaller and [more powerful], I think it will be coming on as a help for interfacing with computers. Voice recognition will be very handy.

Steve Leininger: In the 15-year time frame, I think you'll have perfected speech input and output. I think a computer will become conversational. To be able to consult experts system-wide in a voice mode, we're probably talking about 15 years out.

Wayne Ratliff: Someday, we're going to be able to talk to computers, and they are going to understand what we say. At least in some form or another, they are going to understand at least as well as a keyboard can understand what we're saying, and that is going to be a giant change in computers.

Dick Pick: I think we'll have a talking typewriter, so that when you talk in continuous speech, you see your words on the screen. It's not going to be a generalized

continued

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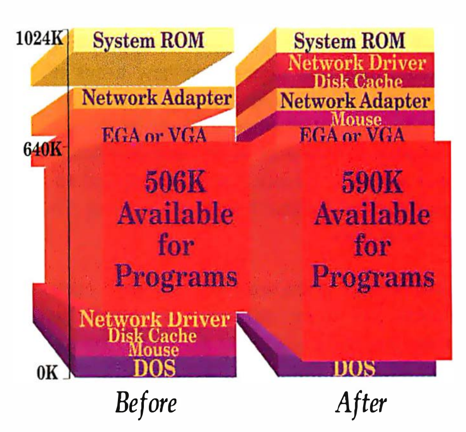
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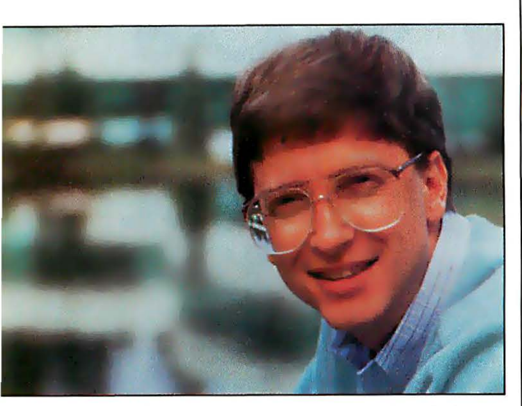
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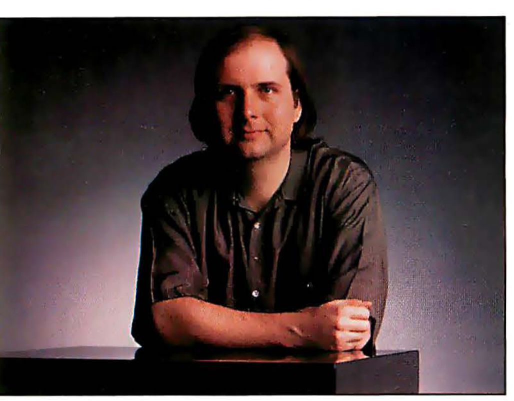
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William H. Gates III is cofounder, chairman, and CEO of *Microsoft Corp.*, the world's largest personal computer software company. While still an undergraduate, he and Paul Allen developed a BASIC implementation for the MITS Altair and formed Microsoft.



W. Daniel Hillis is cofounder of *Thinking Machines Corp.*, which produces the massively parallel Connection Machine. His current research is on evolution and parallel learning algorithms.

algorithm that's going to do all speech. It's going to start out and gradually understand you, personally. You'll need a fair amount of processing power for that.

Ed Yourdon *(see page 366)***:** One of the big limitations up to this point was the number crunching required to process human speech. But if you have a machine that is 1000 times faster that sits on your desk, it may be possible.

Dick Pick: I think for the first time, you really can justify some of the processing power in those machines. It's really kind of interesting, because in the last 20 years, you've gone from CPUs that were almost 100 percent utilized to CPUs that are almost 100 percent unutilized.

Dick Shaffer: I think there will be commercial possibilities in voice-recognition dictation systems.

Gary Kildall: We've had trainable voice-recognition devices for a long time, but it seems we're getting better, and speech is getting better.

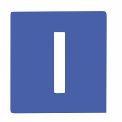
Esther Dyson: In order to do [voice recognition] effectively, [you] would also need domain-specific natural-language understanding.

Dick Shaffer: I think there are application possibilities that depend on new areas of software, such as natural-language understanding. A lot of what needs to be done—and what will be done with computer power over the next decade—will be applied toward getting the machine to know what it is we want done.

Bob Noyce: Even with sophisticated computers, processors still can't do things that many two-year-olds can do—e.g., recognize Mama. I think there are a lot of opportunities in [pattern recognition].

Wayne Ratliff: Even long before that there are going to be other things; expert systems, I think, are kind of fascinating. I really think there is a lot to be done there.

Ken Sakamura: Clearly, intelligent objects are going to be an important trend in the future, and I'd want my company to be in on that. Computers already exist in most of the electronic gadgets that we own—microwave ovens, VCRs, watches. What's needed is a way to connect all these computers together. I think there's great potential for applications that can allow data to be exchanged between a PC and a VCR, for example.



I would advise anybody, find out what everyone says won't sell and do that.

—Lee Felsenstein

Dick Shaffer: I think there are a lot of things that won't happen. I believe that computers will do many things that look intelligent but that they will not "think," and I think that's good. I don't want a computer to think; I want a slave. I want a machine that does all of the boring, mindless things that I have no intention of doing.

BYTE: ***Is there any final piece of advice you'd like to give to someone trying to start a new business today?***

Lee Felsenstein: My advice to anybody who is going into business or starting a company is, stay away from venture capital as much as you can. Raid the cookie jar or whatever, then plan on a situation that is not necessarily high-growth at the outset. Do your work. Do it for important technical reasons, and understand what you are doing. Be able to explain what it is you're building, and make it something that explains itself. Once you do that, you've got a chance of being able to secure the financing when it's necessary.

David Evans: The way I work, I have to have this sort of a feeling of discovery. This is wonderful and new, and the world will be better or different if I do this. I think that I'll never wind up in a start-up where you've gotten to what it should be by some analysis process. If you look at NeXT, for example, in many ways that's as ordinary a computer as you can find. But there are people who are sure it's not, and [that] it's the key to the next generation for everybody. And I think you sort of have to have that kind of emotional commitment to make it go. ■

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INSIGHTS

Lee Felsenstein:

On the De-Sovietization of the Software Industry

What I look for as one of the benefits, or one of the results, of developing a joint U.S.-Soviet personal computer industry is that we'll learn how to de-Sovietize our industry.

Now I define Sovietization, or Sovietized, as [something] run for the benefit of management. And I think it's been very evident that there's been a process under way [that] results in incremental improvement in the product performance as it should matter to the customer, and really retrograde development in terms of the resources that the product needs. It's as if the efficiency of the personal computer continues to decline. This is called *progress*. Why, I do not know.

I have an analysis of this. [I know this] astute programmer, and I asked him several years ago, "What is all this about 16-bit processors? Can they do anything that 8-bit processors cannot do?" (And, of course, being a hardware designer, I knew enough of the answer.) He said, "Well, now, it's true, they can't do anything really [that 8-bit processors can't], but they are better for using with high-level languages." (I think I'm missing a step here. It's like a little catechism.)

[I then asked,] "What do high-level languages get you? Can you do anything with [high-level languages] that you can't do with lower-level languages?" He said, "No, except you can use cheaper programmers." And so that has been the development of the software industry as I have observed it.

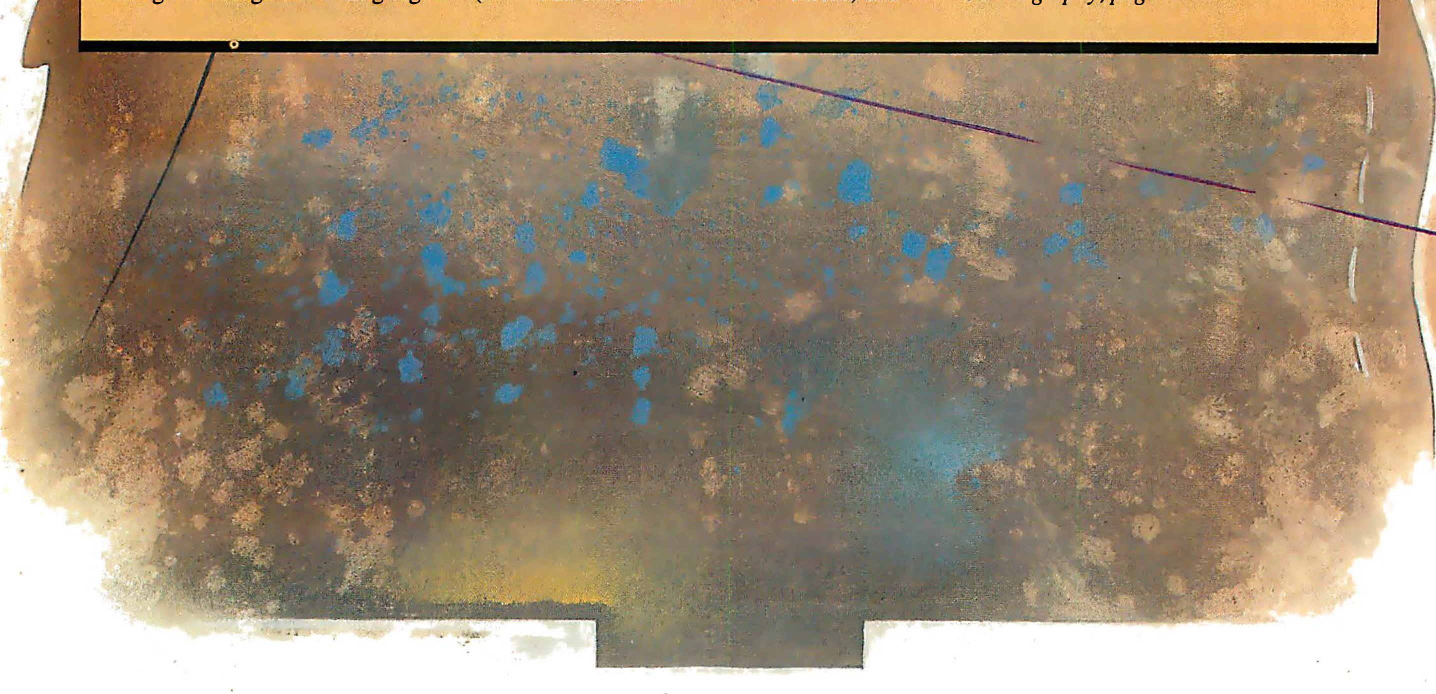
The same programs, pretty much, [are] being written with ever higher and higher levels of language, being created with structures—industrial structures, in effect—of programmers, in which everyone is filling in boxes inside of boxes. And the people [who] should know what [the software is] doing, up at the top, play musical chairs. Nobody, therefore, knows what the product is supposed to be. Whatever comes out is years late, full of bugs, and the next new and improved version will fix some of the bugs.

This is performance directly out of the manual for Soviet state industries. The last thing on the list is a product hat is efficient, a product that does things that no one has ever done before, and a product that is useful and usable by the users without requiring that they vastly increase their hardware.

And I, as a hardware designer, am the continuing recipient of complaints, in the terms of, "Well, we must have more resources. We must go faster. We must have more memory." We see some sort of exponential curve developing now, which is going up, in terms of megabytes, in terms of what is the minimum memory you must have for an IBM system.

So, every version of Windows that comes out jacks up the minimum floor in megabytes. And it's all rather obscene when you think about where it came from and what the concept was. I mean, somewhere, there is a microcomputer there, but I wouldn't be able to tell you from all I hear. Megabytes and megabytes of memory, all kinds of caching and swapping and stuff. And there's nothing micro left about it, except possibly the physical size of the chips.

Editor's note:
See biography, page 246.



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if You Put it Together.







Absolutely! Intel will lose their monopoly over the 386 architecture.

—Michael Slater

What technological advances will we see in the 1990s that result in improved computer systems?

Jim Blinn: What really goes on is a very slow evolution. Things get a little bit better every month—no major breakthroughs, no stunning things—every month 1.2 times as much storage as the last month, something like that. Nothing real radical. But if you stand back and look at that over five or 10 years, that's a big difference. It's kind of a slow evolution.

Mitch Kapor: That continuing, underlying exponential increase in capability is really going to be the fundamental technology driver.

John Cocke: I believe you [will be able to] build, more or less, any kind of machine you want in the next 10 years on a few chips. The density is going to be so fantastic that it will be hard to predict exactly what people will build. But they can build more or less what they want, and have [it] very fast.

Bill Joy: We'll see 64-megabit RAMs, and we'll see flat-paneled high-res displays, and portable machines, and ISDN, and fiber-optic networks, and 32-bit secure operating systems, graphical prototyping software, the beginnings of voice input, and all sorts of things that people have talked about for so long. Those will all be available.

Dick Shaffer: We should see, toward the end of this decade, tens of megabytes of main memory in desktop machines. It would be very easy, in my view, to have 16 MB in eight or nine chips by the end of the decade.

Chuck Peddle *(see biography, page 325)*: Memory technology continues to drive the processing capability we've got. Four-meg memory is an enormous scientific breakthrough. We're going to live with the process that makes that for a long time, and I think you're going to get some great products out of it.

Dick Shaffer: We will not get much beyond 32 address lines, because there's no need to address that much physical memory, and there's not time to do it. Do you know how large a number 2^{64} is? It's 18½ quintillion. The 32-bit microprocessor in the generation that is with us now will be with us for at least a decade. It will be the longest-lived microprocessor generation ever.

Bill Gates: The address base now is this 4-gigabyte, 32-bit address base, and it will be fairly late into the nineties before that starts to pain us. We'll probably skip from a 32-bit to a 64-bit address base. That will last us a long time. Even the 32-bit—the mainframes have gotten [by] with that for a long time.

Gordon Campbell: I think you're going to see a pretty predictable progression of higher-density DRAMs. No one really sees a huge barrier until we get down to about a quarter of a micron. What that basically suggests is that we have five or six factors of 10 [to go] to still add productivity in semiconductors. I think by the end of the decade, we'll be approaching that quarter micron. What that would suggest is that we have a lot of productivity we can contribute before we hit that barrier.

John Cocke: I believe we will certainly have [CMOS scaled to] less than 2000 angstroms—that's 0.2 micron—numbers less than that. I would expect to see large caches and things come, even on desktop machines, and very dense memory.

Jack Kilby: I don't think we'll see much of the combination [of gallium arsenide and silicon]. There are inherent incompatibilities of lattices, and the process will be too complex. The reason integrated circuits moved so rapidly is because making them was a relatively simple process. Remember how hard it was to get people to use bipolar and CMOS? They were very resistant to even this.

Doug Engelbart: The underlying phenomenon is, I keep expecting there to be some real shifts away from the semiconductor. By my figurings, in the fifties, semiconductor phenomena would run into a limit that was associated with impedance and ca-

ILLUSTRATION: CATHARINE BENNETT

pacitance problems, whereas other phenomena, even mechanical ones, could potentially start operating down there. So I just have a feeling that at some point there really is going to be a shift, whether it's to high-temperature superconductive or a nanotechnology sort of thing.

Rich Malloy: As far as chip design [goes], I think we may be bumping into a physical boundary, where the traces on the wire, the equivalent of wires on the chips, are so small that they cannot get any smaller. But people may be able to go around that problem using other types of technology, using parallel technologies. And I think parallelism will be a real hot topic in the next few years.

Jonathan Titus: I think we'll see advances in the ability to do things in parallel on the chip, and also the ability to take some of the tasks that the main CPU does and transfer them to some intelligent coprocessors or auxiliary processors, much the way that was done for graphics control and for math coprocessors. It strikes me that we're in desperate need of some I/O coprocessors to remove that bottleneck from the CPU chip.

Ryoichi Mori: We will, of course, see significant progress [in] storage devices, CPUs, and I/O systems. However, such progress will not solve the problem of the smooth distribution of digital information.

Steve Leininger: I think you'll have dedicated power to the I/O channel—the user-interface channel, if you will.

Paul Carroll: I think the improvements in CPUs will be dramatic but kind of predictable, because they'll follow more or less the same curve that they have for a while. I think that you'll start to see many more things integrated onto that main chip, to the point where you will basically have a full computer on a chip, with the exception of the memory.

Ken Sakamura: I think a big trend will be toward single-chip systems—CPU, memory, BIOS, I/O controllers—everything on a single chip. This is the way we've already done things in TRON, and it's very effective. This may be a slight exaggeration, but I think when you open the case of computers at the end of the 1990s, you're likely to see nothing but a single chip inside.

Jonathan Titus: And I think, too, we will see more and more the incorporation of digital signal processing close to the central processing unit as well. [This is driven by] the requirement for extremely high-speed mathematics, both in vector operations and in matrix operations. The architectures of those chips are set up to handle them beautifully.

Gordon Campbell: The other thing I would expect to see is brand-new memory architectures where, instead of looking at memories more as serial devices, we'll see massive parallelism, which means that we can basically input and output data at much faster rates. I would expect that we'll see CPUs individually that can process up to 50 to 100 MIPS by the end of the decade.

Dick Shaffer: My guess is that about that time, we will have parallel architectures—massively parallel in the sense that they will use commercially produced microprocessors of no more than 32-bit width in parallel. My guess is that the AT design and the Intel architecture will still be dominant, but that we'll see microprocessors with memory and most other parts of the PC built into them.

Federico Faggin: The single most important event in terms of traditional microcomputing would be the use of massive parallelism and the appearance of chips that will contain two, four, 16, 64, and on, powerful processors in them, and of course, the memory as well.

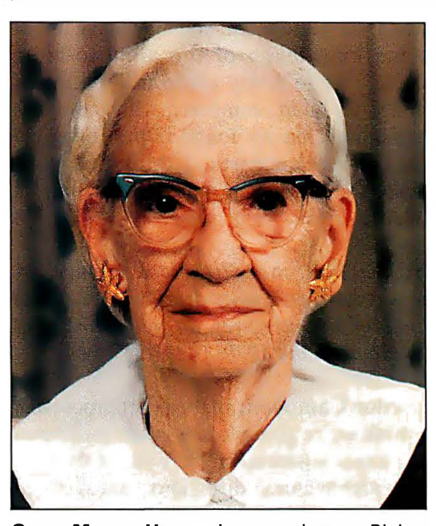
Mitch Kapor: I think parallelism and parallel computing [are] going to become commercially very important in the next decade, particularly on architectures that use multiple RISC microprocessors in a scaleable fashion. I think that the research breakthroughs have to do parallel algorithms for doing the software automatically, so people will write software pretty much the way they write it today, but the compilers and other tools will figure out ways to very efficiently use multiple independent processors.

Tony Hoare: People who can take advantage of large-scale parallelism and produce interactive supercomputer applications will surely find a very ready market for their products.

David Evans: At the level of building computers, we're dealing with the bulk properties rather than with the properties of atoms as they are connected together. I just feel that there has been a lot of success in doing computer models at the level of atoms and

continued

C. Anthony R. Hoare (not shown) is professor of computation at *Oxford University* and the 1981 recipient of the A. M. Turing Award. He is a noted authority on programming theory and languages. His current research deals with parallel programming and communications processes.



Grace Murray Hopper is a consultant to *Digital Equipment Corp.* She is a pioneer in the development of standardized application programming languages, including COBOL. She is a Rear Admiral (retired) in the U.S. Naval Reserve.

bonds and being structured so that people can see those models and understand, from what those things look like, something about how they'll behave. We're going down to where the numbers of the layers in the integrated circuit are not very many atoms thick. It seems like you can expect that when you get to there, you may make use of some knowledge of the atom-to-atom things. We're pretty crude in the kind of things we build, compared with the memory things that are found in the living organs, living creatures. I think that we'll make use of a much more refined way of relationships.

BYTE: ***Well, then, let's look at our current systems on a more detailed level. What kind of architectures do you think will dominate in the 1990s?***

Gordon Campbell: In the microprocessor, I think we're going to see in the mid-nineties a reassessment, if you will, of the current architectural directions, and I don't think Intel will be able to push up a compatible product line much past 1995. And I think the RISC architecture and some of the other things are going to push for the fundamental changes on the processor.

Michael Slater: Well, the usual couple of questions regarding microprocessors are, will Intel [lose] their monopoly over the 386 architecture, and will the RISC architectures overtake the CISC architectures? My feeling on both questions is, absolutely. Intel will lose their monopoly over the 386 architecture. I think you'll see the first products this year and see a number of products next year. I think the 386 architecture will become a multivendor, industry-standard architecture.

Chuck Peddle: There definitely is going to be some sort of marketplace rebellion against the level of control that Intel has.

Gordon Bell: It's hard for me to see how people are going to break out of the current Intel mold, because they have got so much software.

Bill Gates: The Intel architecture will continue to dominate, there's no doubt about that. So the most interesting thing processor-wise is 486, 586, 686—like that—which is pretty evolutionary stuff.

Jay Miner: IBM is going to continue to dominate with whatever CPU it decides to pick. The marketing clout and the image they've got is almost unbeatable at this point. I think others will continue to occur, and some will continue to survive and be successful, as I hope the Amiga will, but the dominant machine is going to [be] IBM for a long, long time, with whatever CPU they decide to pick.

Philippe Kahn: It's difficult to say. The world is going in two different directions. On one side, you're going to have RISC chips that are getting more popular, and on the other side, you have Intel continuing the evolution of 486 to 586 to 686, and I'm sure the 786, whatever that is. So you're going to see different trends—I'm talking about the most popular ones. Clearly, the Intel chip set will be popular, and some RISC chips will be popular.

Michael Slater: I think the RISC processors are going to wipe out CISC processors in the engineering workstation arena. I think they will be much, much slower to take over much of the business market. Multiuser commercial computing will be the first place that you'll see RISC appearing in the business world. As [for] your business desktop computers, I think those are going to stay CISC-based for quite some time. The inertia of the whole PC market cannot be underestimated.

John Markoff: From my point of view, it's going to take a long time to unseat the CISC architectures because of software inertia. But, at some point, the cost issues and the performance issues will be just unavoidable on the RISC side, and the RISC people will be emulating CISC at the same performance levels that CISC will obtain, and it will be easier to shift over in the future. However, I think the big wins are parallel architectures, coupling together dozens or hundreds of RISC devices.

Paul Carroll: I think that it's even possible there will be a merger. If you take a look at the 486 at the moment, as I understand, it has some RISC attributes. I think there's a digital signal processor part of that chip that is a RISC technology.

Dick Pick: Well, obviously, it's kind of an oscillating thing, going back and forth between complex instruction sets and reduced instruction sets. Basically, that's all tied to where we are in terms of the number of elements that you can put on a chip.

Lee Felsenstein: The possibility of using small die sizes, fast technologies, and a balancing of the memory capability with the processor capability is really what RISC is about. I think that that will really come into its own in the next five years, but no sooner than three years from now—my guess.

Jim Manzi: [You'll see] accelerating advances in RISC, and you'll have a 486, and a 586, and by the end of the decade, we'll see a 986. I wouldn't underestimate the amount of momentum around the primary architectures, either—the Intel world, the Motorola family. But RISC will become increasingly important. The advances in CISC architectures will continue at an accelerating rate as well.

Rod Canion: RISC architecture will be important, although I don't think we'll see one RISC chip or the other dominate. It will be simply the use of RISC architecture in the processors that become the standard processors.

Ken Sakamura: I'm not very optimistic about the future of RISC. It uses too much power.

Danny Hillis: Well, I think it's bimodal. I think that certainly it is clear that RISC processors are becoming occasionally important. But I think that the interesting architecure will not so much be the architecture of the individual computer; it'll be the architecture of the whole network. I think the computing device that people will use is the network, of which their computer is only the window into it.

BYTE: ***What kinds of storage devices do you think we'll see?***

Michael Slater: A hard disk capacity of 100 MB is probably a base-level capacity that everybody will have, and a couple of hundred MB for the more serious users. Optical storage may or may not be a significant player. I think CD-ROMs will become important as a distribution and database medium. Whether optical read/write drives become significant as an alternative to Winchester hard disk drives, I think, is still an open question.

John Warnock: Read/write optical clearly has a future. But you never know what other technologies are going to come along to completely displace them overnight.

John Caulfield: In terms of optical storage, we're at the very beginning. We have read/write disks. They're not very good, but they're on the way. Holographic and

continued


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he single most important event in terms of traditional microcomputing would be the use of massive parallelism.

—Federico Faggin

nonholographic [storage] will allow us to do much faster random-access memory operations on much larger stores of data. There is a variety of such techniques. I get such flak all the time when I talk about holographic memories. In the 1970s, every major high-tech company in the world had a major program in holographic data storage—in this country, led by AT&T and IBM.

Dick Pick: Well, certainly, optical storage, I think, is [coming]. There's going to have to be some clever software to take advantage of it that nobody has really done yet. I think that's probably going to be around for a while.

Jim Manzi: I think that optical storage is really still scratching the surface, though high-density optical storage, I think, is going to change the world in many ways.

Jay Miner: I would say videodisk storage is probably the biggest comer in terms of growth and usefulness and large mass storage capabilities at a moderate cost. Laser disk types of things. Things that store data like disks do. Disk advancements in the area of optics.

Charles Simonyi: Optical storage is sold hard, but I think it is very worthwhile, certainly, in terms of CD-ROM and also in rewritable optical storage. I don't think that is oversold. It is nice at this stage of the game to have the diversity. And I think that new ideas can still emerge.

Paul Carroll: I really think that erasable optical will finally happen in the nineties.

Brit Hume: Optical storage, rewritable CDs—once the endless rewritability of those things is perfected (that is to say, they don't deteriorate) and the price comes down, that [will allow] it to be a major new market. What we're talking about there, seems to me, are improvements on existing hardware.

Gordon Campbell: I would expect to see higher-density CD-ROM with higher data rates. We'll probably see low-cost optical disks that wind up being fairly productive.

Rod Canion: Disk drives will get smaller and [provide] higher capacity and higher performance.

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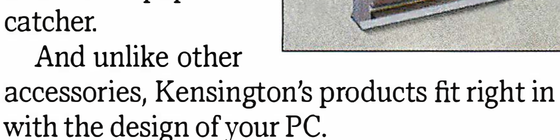
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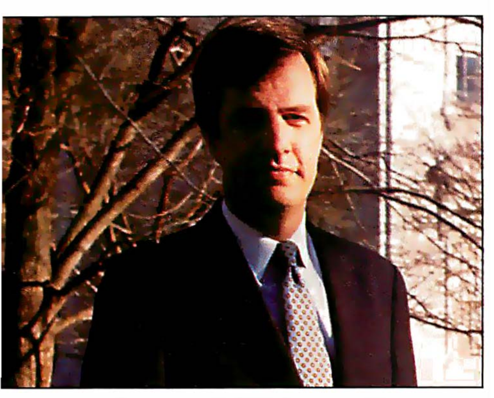
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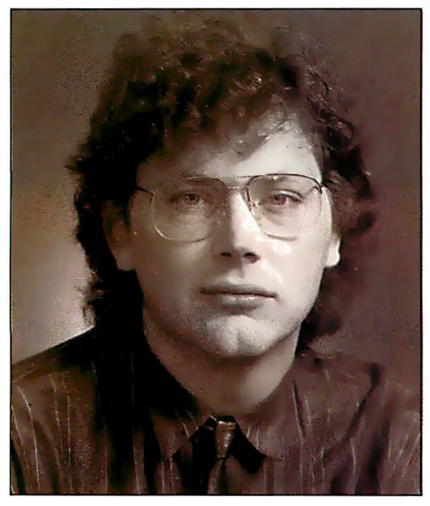
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Brit Hume is *ABC News* chief White House correspondent and a syndicated computer columnist. Previously, he covered Capitol Hill for 11 years for ABC and worked for the *Closeup* documentary series. He was a 1969 Fellow at the Washington Journalism Center.



William N. Joy is cofounder and vice president of R&D for *Sun Microsystems* and is a leading Unix expert. He designed NFS and co-designed the SPARC architecture. He also designed BSD Unix and wrote the Unix vi editor.

Lee Felsenstein: Optical disks will stabilize at this 8-centimeter level. The 3-inch CD-ROM is going to be significant. It will also be portable, as 5-inch CD-ROMs are right now. They're just beginning.

Steve Leininger: It would be neat to be able to record and play back compact disk kinds of things. I'm not sure that an erasable compact disk is as important as just being able to record it in the first place.

I think there's going to be really, really big things in compact disk-based information, data-retrieval something or other. I don't know if that's data bookshelves, or if it's going to be the next library, or something. A lot of it's going to depend on display technology. We've got smatterings of it now, but it just costs too much. But anything, if you make enough of it, all of a sudden starts getting pretty cheap. Look at compact disk players—you can buy those for $150 or less, unless you want to stick it in your computer. Then, it's still $700.

Bill Gates: Optical disks, because they'll be read/write, have a very narrow role to play. All you have is the CD (which is read-only and deserves to exist because it's leveraged off all those consumer volumes), [and] then the read/write devices that have to compete with magnetic. Magnetic will continue to improve. In fact, there are a lot of techniques that will drive magnetic, like the vertical recording.

Rich Malloy: The disk drive capabilities will increase a lot. I think the magnetic disk drives seem to be in a race with the optical drives, and magnetics are reaching a point where opticals were supposed to reach. It's going to be a battle between the two as to which is more cost-effective and which has the higher capabilities. We may see hard drives as small as a little audiocassette, maybe some as small as a DAT cassette.

Rod Canion: People have been predicting the day when optical disk technology would replace magnetic disk technology. I don't think that's likely to ever happen.

Jonathan Titus: I have a feeling that whatever we look at in five or 10 years will still have some sort of magnetic medium. People will have optical read-only disks [so] that if you want a thesaurus or something else—an on-line encyclopedia—you can buy it or perhaps even borrow it from a library.

Jerry Pournelle: I always thought that spinning metal as mass storage devices would go away, to be replaced by some kind of electronic device—something in silicon. I think that over the long run I was right, but over the short run, that was probably the most disastrously wrong prediction I ever made. I thought that by now the hard disk would be gone, and you would be using something like bubble [memory]. Some kind of nonvolatile silicon storage is what I thought we would have by now. I think that's still the case, you understand. It's just that it has taken a lot longer.

Ken Sakamura: Disks are becoming obsolete for many important uses. The real trend will be toward large solid-state memories that use less and less power. We need computers that can run on the power of a Walkman battery. You just cannot make disks that can run on that little power. I want to see fast computers that can run on as little power as possible.

Ted Nelson: Optical system on a disk. The CD-ROM thing is so absurd. They have standardized this dinky little disk. It seemed so big at first. What is it, 40 million bytes? And now, it seems so cramped. With CD-ROM, you are stuck with only what you have in those 40 million bytes, whereas with the networking data vision, you have the whole world—no boundaries.

BYTE: ***Are there any overall advances that we should expect to see?***

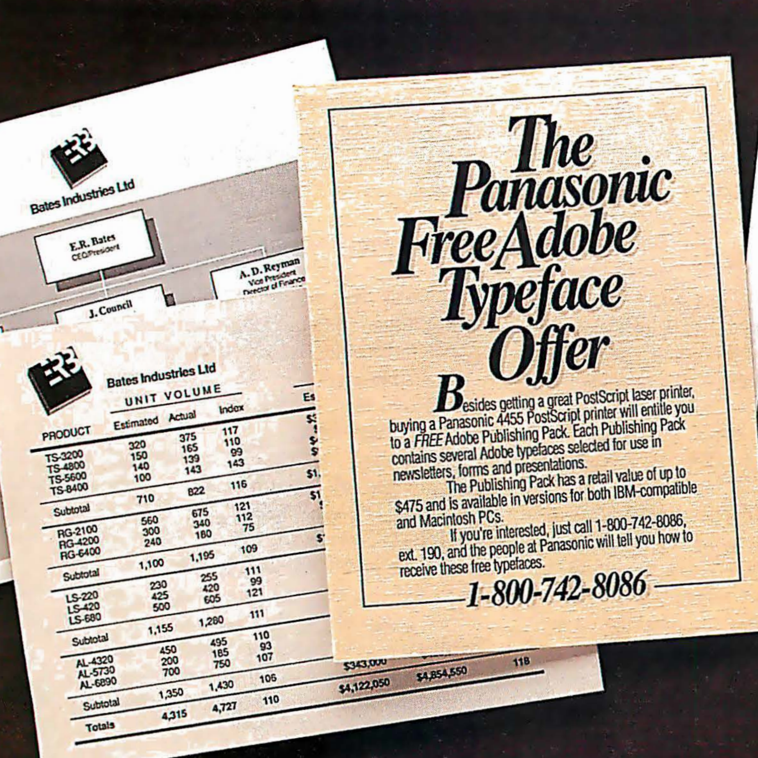
Rod Canion: I think we're going to continue to see standards dominate the computer industry—in fact, in an increasing way. I think what's happening in the PC arena with standards will eventually migrate into minicomputers and mainframes. What that means is that we'll see the concept of truly compatible systems running the same software packages and using the same peripherals, etc., over a much broader range of computing resource power.

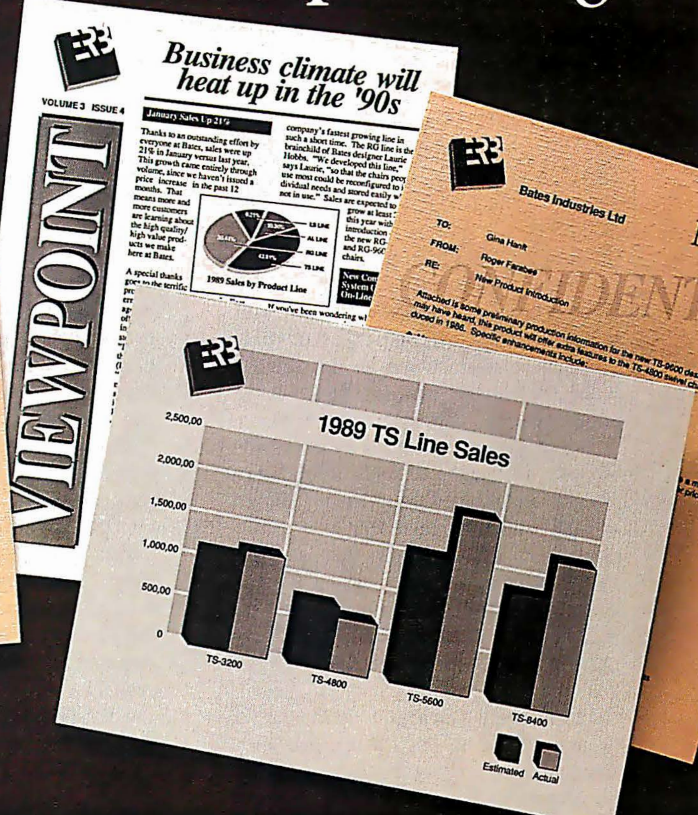
Seymour Papert: Maybe if there's one thing I would pick on, it's throwing away all concepts of standards—to throw away the idea of standardized anything.

Alan Kay: The main advancements we need are a considerable change in the ability of the American businessman to exploit innovation. That's the biggest bottleneck. Innovating is easy: You just rub smart people and money together. The thing that we have fallen down completely on is being able to do anything with it. The Japanese are the ones who go out and do the actual technology transfer. ■

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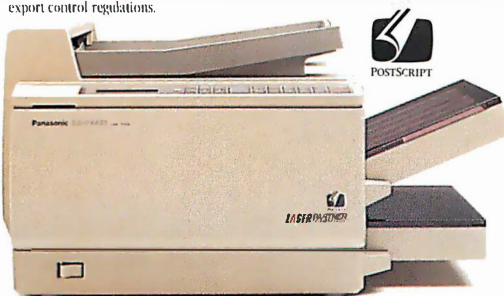




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THE BYTE SUMMIT

INSIGHTS

Brit Hume:

On Computers and Writing

I always thought that writing on a computer makes writing easier because it takes the pain out of revision. And that's the simplest and most obvious point to be made about it. But there's some controversy within the business about whether it makes you a better writer or not, and whether by overcoming your resistance to revision it allows you—it encourages you—to put things down in the first place that you would never have written if you feared you'd have to change it—[that] what [using a computer] tends to do is inhibit, or make less rigorous, the thought process that goes into your original drafting of your work.

I think there's an argument that could be made for that, but I think that with the quality of writing that is being done on computers now, it is pretty hard to argue that that's actually happening, which is not to say that there is not superbly elegant writing being done without them. There certainly is. George Will, for example, writes in longhand, with an old-fashioned pen—doesn't even type—and writes beautifully. But others [using computers] write beautifully as well.

Editor's note:
See biography, page 262.

Ed Yourdon:

On "Pure" Object-Oriented Languages

Well, [pure object-oriented languages] are that much more pure and lovely to work with, but I don't see them taking over the world. I think that it is much more likely that a C++ is going to dominate over a Smalltalk or Eiffel or some of the other ones, simply because you have got that many existing programmers.

The object-oriented purists are violently opposed to that whole concept. And there was a big flap at the last OOPSLA conference on that issue, which got written up in some of the magazines. It was a big panel session with all the famous names prognosticating about what was going to happen with object-oriented languages and so on. And I stood up in the audience during the question session and said, "What do you propose to do with the 3,000,000 existing COBOL programmers?" And the answer was, "Shoot them." Well, that's fine, [so I asked] "What are you going to do with the 81,000,000,000 lines of COBOL out there?" and they said, "Throw it away; it probably isn't any good, anyway." [The panelists were] fairly serious, although they do represent the radical revolutionary component in the object-oriented world.

But in plain obvious fact, you can't shoot 3,000,000 COBOL programmers and God knows how many million C programmers. And equally important, you can't get rid of the billions of lines of existing code in COBOL and C and FORTRAN and whatnot. So I think it is much, much more likely that you are going to see the existing procedural languages extended with object-oriented features over the next five years or so. I just don't see any kind of wholesale replacement with pure object-oriented languages.

Editor's note:
See biography, page 366.

Bill Stallings:

On Moving to OSI

What many companies now are doing is using TCP/IP-based products to hook things together. And there [are] starting to be board-level products that you can plug into micros that support something like Ethernet or Token Ring but also have a lot of the TCP/IP software right on the board, so you can get pretty sophisticated support for distributed applications on micros in a LAN environment by using the TCP/IP.

That has been kind of a main thrust for the last few years, and I think that will continue for a while, and eventually that will start transitioning over to OSI-based products. And that's, maybe, going to be less of a problem in the micro area than in the minicomputer and mainframe area. But it's still an issue that a lot of companies are going to have to face if they've already made an investment in TCP/IP stuff and then they want to transition over [to OSI stuff].

There are a couple of ways that can be done, but there's really no clean way to transition from TCP/IP to OSI. So that's an area where there will be a lot of attention over the next few years. And then, the other is direct support for ISDN for personal computers and workstations. Those kinds of products are starting to show up. There will be more applications using those.

Outside of the IBM and SNA environment, [TCP/IP will be the main way to connect NetBIOS-based and PC LANs to other types of networks]. And even in IBM there's more support for that. But right now if you want to do something that's standardized, the way to go is TCP/IP. And there's a lot of software [and boards] out there, not just for Unix-based systems, but also for NetBIOS kinds of systems.

Where's OSI?

What has happened [is] OSI is just taking too long to get out the door. But, sooner or later, companies that make a heavy investment in TCP/IP are going to have to face a transition issue to OSI. But that's not to say they're doing the wrong thing by going with TCP/IP. It's the way you have to go right now if you want to get networking capability in to get the interoperability.

A couple of things [are missing in terms of OSI]. One is just simply the products, particularly at the upper layers, the application layers. There's still not a lot of software out there. A second problem is that at the lower layers, the transport layer and the internetworking layer, the standards have solidified, but there's just not much experience with them. What the TCP/IP community has found is that the software is so complex that it's just not something that you can plug and play; there's got to be a shakedown period. As vendors start bringing out OSI-based transport and internet software, they're going to find that they don't easily talk to other vendors. And the customers are going to get caught in that kind of a bind.

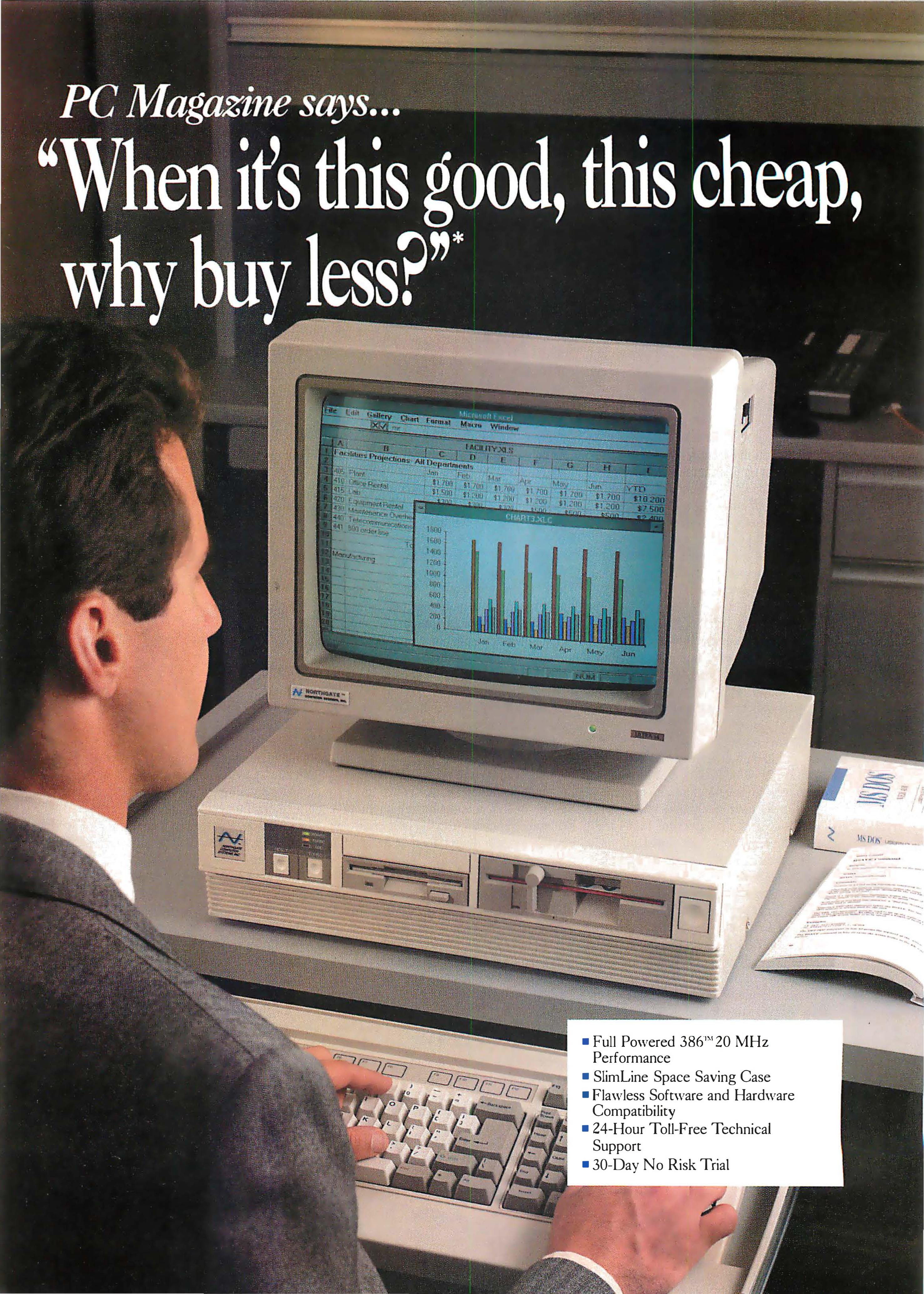
It is [ironic]. The way the industry is trying to respond to that is by certification, like the kinds of things the Corporation for Open Systems is putting together—certification test beds. Say, if a vendor like DEC comes out with an OSI-based product and they go and get it certified—that means that their product will interoperate with a test bed. And a test bed is something nobody will ever buy or use. If Hewlett-Packard also gets a certification, it doesn't absolutely guarantee that those two will play against each other. The mathematical tools really aren't [there] to verify all this stuff. It's still as much an art as a science.

You have to get the products together and have them interact with each other, and see what happens. When you do that, you find flaws in the vendor products, and sometimes you even find some flaws in the standard specs. And I think that there's still going to be, for the next few years, things showing up. Because actually it's a remarkably small amount of experience with the OSI-based products. So, I think that there are some problems looming there that we'll see in the next few years.

Uncle Sam Goes First

I think [the transition to OSI] is really starting—I'd say within the next year or two—within the federal government and the military. They have developed some tools for doing a transition, and they are pushing rather hard to get to OSI. The first substantial body of experience you're going to see is within the U.S. military as they start to make that transition. But they're being driven to it by policy decisions, which companies don't have to face. And I think companies are going to put it off until they have to do it. And I think that means putting it off four or five years at least. I think in the mid-nineties there's going to be a lot more in terms of products and approaches for doing transition than now. Some of it will be spun off from the way the military has done it, and some will be other approaches that people are trying.

Editor's note:
See biography, page 352.



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THE BYTE SUMMIT

FLASHES OR SMASHES?

Which technologies do you think will change the way we compute in the 1990s, and which will be flashes in the pan?

Chaos and fuzzy logic are ways of life. They will be with us and won't go away.

—Bob Noyce

BYTE: *For example, ISDN, FDDI, optical computing, neural networks, fuzzy logic, and chaos?*

Jack Kilby: I'm not sure any of those technologies you mentioned will be flashes in the pan. The trend is that technologies will exist side by side. The process in the past has been both serial and sequential. Newer ones are options. Fuzzy logic, for instance, isn't going to wipe out things that have gone before.

Gordon Bell: They're all components. I think those are all important components.

Grace Hopper: I think they're all part of our future development. We don't know where these things will fit in. They keep trying to say final things in too young an industry. It will be scattered all over, dispersed.

BYTE: *Let's take them one at a time. How about ISDN?*

Bill Stallings: ISDN, in a way, has kind of missed a window. It just took them too long to get the standards out. It took them almost a decade. So a lot of companies are going in other directions. They're using T1 and fractional T1, and satellite-based systems, and package switching, going into higher-speed package-switching networks. And so ISDN has just ended up being one of a number of options for companies. So, unfortunately, it's not going to end up being the universal solution that the planners had in mind.

Steve Leininger: Right now, everything I have seen suggests that it's too expensive. The fact that they're working on some standards there is encouraging.

Jonathan Titus: A number of different ISDN-type standards have sprung off from [ISDN], and those are incompatible. So, although it's touted as a standard, I'm not quite sure how much of a standard it's really going to be worldwide over the next five years.

Rich Malloy: ISDN has good promise. The problem is it's moving so slowly. By the time it gets implemented, it may be surpassed by other high-speed systems. And I think the people involved in it should just get their act together and start working on a common standard.

Jonathan Titus: I'm not sure that ISDN will ever get to the point where it has enough critical mass behind it to propel it to the point where people just think about hooking into it as a second thought.

Doug Engelbart: ISDN. The pressure toward that kind of service is immensely high. Whether it was formulated appropriately for what the market and the need [are] going to be in a technology, I don't know.

Jim Manzi: I think ISDN is going to be incredibly important, and that's going to be very, very real.

Paul Carroll: I think that ISDN will happen, but I think it will be five years or more, five to 10 years probably, before it has any appreciable impact.

Dick Pick: ISDN, this is interesting. The whole thing is, nobody's really solved the problem of truly integrating voice and data—distributing data and voice around the network, and I think that's going to be one of the big hits in the next 10 years. Someone's going to do that. I don't know if it is going to be ISDN.

Bob Frankston: ISDN is a catchall phrase. ISDN itself has changed. The original conception of ISDN, back in the early days, was [that] one day we're going to throw a big switch and convert the whole phone network, because that's the only way to make change. What we've learned since is that you can do it piecemeal. It's really access to the information and services.

ILLUSTRATION: CATHARINE BENNETT

Nicholas Negroponte: Narrow-band ISDN (two 64K-bit and one 16K-bit line) will be a flash in the pan. In fact, I don't think it will take off. I think we will leapfrog it. Europe and Japan are paying more attention than the U.S.

Ken Olsen: Oh, ISDN's not bad. We love ISDN because our customers love ISDN. And we support ISDN. Very few really support ISDN, I mean in computers. But ISDN means many things to many people. One of the most important things ISDN meant was that you bring the thing to the desk, one wire, 62K bits of voice and 62K bits of networking for your desktop device. And 15 years ago, 10 years ago, that would have been wonderful. Now [it's] a joke.

Bill Gates: ISDN, I mean it's nice in a way, but its time frame for widespread use is way out there. Even the bandwidth you get out of ISDN isn't that much up for a normal line, even though it's in the right direction.

Gordon Bell: I think ISDN—when that comes, that's probably going to be a really remarkable kind of thing because you're interfaced. But on the other hand, I think what's going on now is pretty remarkable.

Ken Sakamura: I think ISDN is going to be extremely important. It's exactly what the market wants. It's going to be very big.

Stewart Alsop: I believe very, very strongly in ISDN, and I think it'll have to become a standard component in every computer. It's funny, because I'm not exactly sure how you do this. But I believe that local networking has to be a standard component as well, and maybe ISDN becomes a chip set that's made subsidiary to the local network.

Bill Stallings: I guess the only one that I have a really set feel about is ISDN. I see that, as we go over the next few years, as being one alternative to offer people for networking. I think the thing that would turn home users on is broadband ISDN, where you start to get video applications and more use of image.

Nicholas Negroponte: Broadband ISDN will happen. Whether it's called ISDN doesn't really matter. The whole notion of very, very massive—in some sense unusable—amounts of bandwidth into the home is going to happen anyway, no matter who does what.

Bill Stallings: I think there'll be a lot of niche opportunities in broadband ISDN. I'm not quite sure what they will be, but when you get to the point where you've got wide-area networking capability in the hundreds of megabits per second, the carriers are going to be able to offer the basic, just raw, transport of that stuff. And they'll offer some value-added services. But it seems to me there's got to be a lot of different places that you can position yourself to take advantage of that.

Ken Olsen: You're not talking about broadband into the desk. ISDN is a typical telephone-company thing. When I first heard of it 10 years ago, I thought it was really clever. Now, that technology is ridiculous. Putting 62K bits on the desk and open wire sounded like great stuff. Now we're talking about 10, 20 times that.

John Markoff: I have real skepticism about ISDN. You have to plug it into the wall, which seems to me a real problem with the technology, and the bandwidth isn't that big. The political issues are almost more interesting than the technology issues.

Alan Kay: The Japanese say they're going to be 100 percent fiber into everything, including homes, in 2010. The projections I have seen for this country are 50 percent. The difference between 50 percent and 100 percent is not just half, because it's demographics. [Thus,] 50 percent penetration of fiber means probably 90 percent business.

BYTE: ***What about fiber optics, specifically FDDI?***

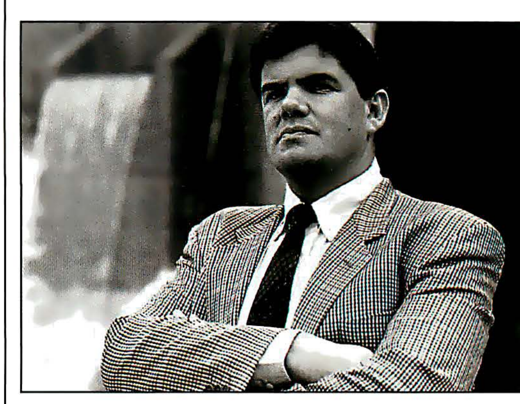
Niklaus Wirth: One area that will certainly have influence is the even faster speed in communications through fiber optics. Whether that is really needed depends crucially on the kind of application you have.

Jonathan Titus: FDDI seems to be the strong one, and the one out in front at this point. I look to that for real strength in the future.

Paul Carroll: I also think that FDDI will happen. It just seems to me like it's a natural progression. I'm not sure that it'll happen in a big way for a while, because at the moment, you don't need that kind of bandwidth going from my PC to your PC.

Bill Gates: Use of optic-fiber networks in the office network will be very important. We actually will finally get some integration of the PBX system with the local

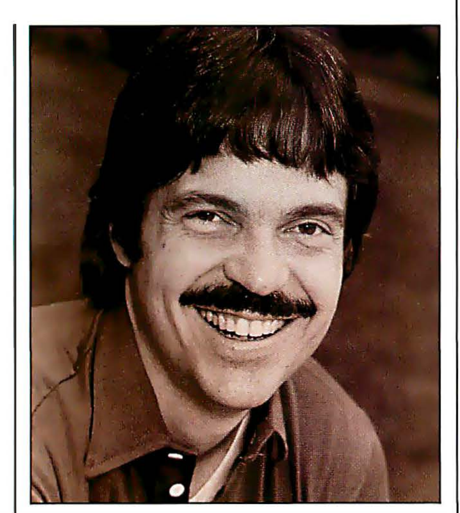
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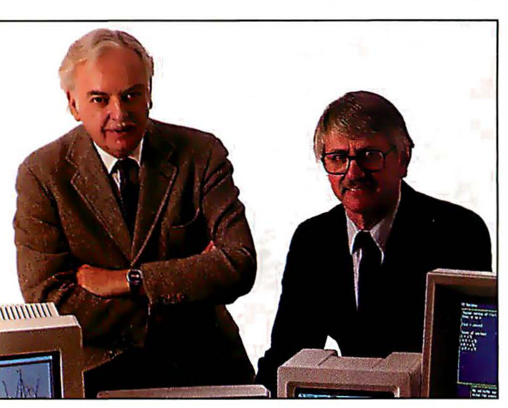
Philippe Kahn is president and CEO of *Borland International*, which produces applications software and programming languages. He is a mathematician by training and studied for a time under Niklaus Wirth.



Mitchell D. Kapor is chairman and CEO of *On Technology*. In 1982, he founded Lotus Development Corp. and served as both president and chairman. He and Jonathan Sachs created the original version of Lotus 1-2-3.



Alan Curtis Kay is an *Apple* Fellow. His charter is to investigate new ideas in computing. He helped found Xerox PARC in 1970, where he refined the concept of the Dynabook and developed the Smalltalk programming language.



John G. Kemeny and **Thomas E. Kurtz** created the BASIC language and cofounded *True BASIC, Inc.* Kemeny retired last year from the faculty of Dartmouth College, where he was a former president and professor of mathematics. At one time, he was a research assistant to Albert Einstein. Kurtz is currently a professor of mathematics at Dartmouth.

computer network and some phone functions on the desktop with the computer.

Brian Kernighan: The thing that I would like to see happen more than it has is for better communications, reasonably high-speed communications, to people's homes, so that, in particular, the kind of central computing environment that I take for granted I could have better at home. The bandwidth is something that's already there because of cable, but it is hard to get at.

Jack Kilby: Fiber-optics technology is [a] hot area—as it goes into the home and office. People want high bandwidths for commercial applications. The great hope of fiber optics is that bandwidth is free and big. The big question is whether or not we get to use it.

Bill Stallings: With FDDI and some of the follow-on products, you're getting very high data rate local-area-network environments and server-based applications that would take advantage of that [high bandwidth] capacity.

John Markoff: FDDI will come very quickly because it's an evolutionary step up from Ethernet, but I think with processing power moving the way it is, FDDI will soon be seen as a bottleneck.

John Caulfield: Optical communication [is] clearly a very preliminary, early thing. What the industry uses and installs is always far behind the state of the art. And FDDI, the new standard protocol, is far behind the state of the art and is being implemented [in] various places. I expect FDDI to be with us throughout the next five or six years anyway, and maybe throughout the present century. Once we get used to that, we'll go to something far, far better. New standards will be introduced that will allow far better networks and will involve both wavelength division and time division.

BYTE: ***The whole area of optical computing is an interesting subject. What kind of future do you see for that?***

John Markoff: Optical computing seems to still be a long way away. Lots of promise, but I think where it will come first is in the phone system. The switches are just so much more convenient with a fiber network to keep things in optical format all the way through, rather than switching it back and forth between them. So that's sort of logical.

John Caulfield: There are clear niches that belong to electronics, clear niches for optics. In the early stage, those companies that want to form will do well to stay out of the battles—to go where there is no competition. The goal is to build computers—not to build optical computers or electronic computers.

Rich Malloy: Optical computing, that's probably something that will be 10, 15 years away before we start using it to any degree. I think as that gets more feasible, the conventional ways of doing things will have advanced to the point where the advantages of optical computing will not be so great to justify the cost.

Ken Olsen: [Optical computing is] unlikely. There's an awful lot of logic in a chip. You see, light really doesn't go any faster than electricity. Well, it really does, but electricity in a vacuum goes about the same speed as light. Electricity on a wire goes about the same speed as light does. If you make it much bigger than a chip, you lose lots of speed, even if it's light.

John Caulfield: I would pick a task where it's possible to do the task optically, and it is essentially impossible to do it without optics, so that we are in no way in competition with electronics and yet benefit from all the advances that we anticipate from electronics. And then the problem becomes how you define those niches. And I think I can define some of them.

Doug Engelbart: So many things are going to shift. The optical thing is potentially that sort of shift in phenomena harnessing that may well pop up.

Paul Carroll: Optical computing—I think that's an interesting idea, but I don't think that even the proponents of optical computing think that anything at all will happen for three or four years. My guess is that it will be more like 10 to 15 years before there's even a chance that anything will happen.

Jim Manzi: I think optical computing is a long ways off. I guess the best work is being done at Bell Labs. They've demonstrated the concept very, very successfully. There is a long way to go there, obviously.

Charles Simonyi: Well, I don't think that optical computing is oversold. It is just [that] I see the promise as very uncertain—but then I don't think that, apart from some media hype, it is a serious issue.

John Caulfield: Optical computing, in my judgment, will only be real in well-defined niches. It will never replace electronics. It will be found to become merged with electronics. We let electronics do what it's good at and optics do what it is good at. Neither is replacing the other. There'll be niches that are ideal for electronics and niches that are ideal for optics.

BYTE: *Where do neural networks fit in?*

Bill Joy: Late in the decade, I think the real breakthrough will be if we can begin to use things like neural networks to take more analog input.

Paul Carroll: Neural nets I'm a little more skeptical about. That's kind of an interesting thing to play around with, but I have a feeling that [it] could turn out to be one of those technologies with a great past.

Jonathan Titus: Neural networks [are] an area that deserves a lot more attention, because I think if you read George Gilder's book *Microcosm*, he makes some excellent points about the fact that digital technology one of these days is going to run out of gas. Simply because we're trying to do the same old problems in the same old way, just dashing more bits and more bytes, and doing it faster and extending word lengths. But the way the eye works and the brain works is in the analog realm. He holds, and I agree, the analog realm will come of its own when we get into some more powerful neural-network-type chips and the software to control them.

Dick Shaffer: Neural networking is a possibility. I think it is potentially useful in the sensor area, and that's about all I see.

Niklaus Wirth: First of all, we do not really know what we want to do with [neural networks]. Secondly, we don't know how neurons work, so let's build them and combine them? Perhaps one aspect that is interesting there is if they are connected with sensors—analog technology.

Federico Faggin: I personally believe that [neural networks] will eventually change computation by adding a fundamentally new paradigm to the existing paradigm—not by replacing what exists, by adding something.

John Markoff: The neural-net stuff is very interesting, but I think it will come into play first in terms of interface issues—voice recognition and vision.

Dick Shaffer: I think neural networks might be useful in data reduction, especially in the area of vision. You look at an animal, for example, and you know from neural electric studies of the optic nerve there's a lot of data reduction that takes place in the back of the eye. Instead of sending a bit of information for all the thousands of points of light that strike the retina, you get reasonably reduced signals. Aha—something moved. Or, nothing moved. Or, something moved from upper right to lower left. A lot of reduction takes place. Neural networks for large arrays of processors could be useful in that.

Mitch Kapor: The commercial impact of the various biocomputing techniques, things that might emerge from neural nets or chaos or complex systems and so on, I think is more than a decade away, maybe more than 15 years away. It's still very, very preliminary, very interesting stuff, a whole different way of looking at the world and doing these sort of bottom-up intelligent systems, but I think that's still a long way away.

Federico Faggin: When you have to have machines that operate in the real world, in real time, then you will have to have both [traditional and sensory] elements in them. The sensory part, and the sensory processing, and the pattern recognition, and all of those things, will be done more readily with the neural networks. The logic processing will be done more readily with computers. In other words, it will be a little bit like left brain and right brain—you know, solving the problems together. Each paradigm is good for certain things and not very good for other things.

John Caulfield: Neural networks—big neural networks—will have to be optical. Small neural networks will almost have to be electronic.

Steve Leininger: You'll get me up on a soapbox [about neural networks]. I think the brain's a little more complicated than just what they are trying to do right now, maybe a lot more complicated. For a neural network to do something, you have to feed the silly thing.

Federico Faggin: The fundamental thing here is another way of learning how to manage parallelism—massive parallelism—but, however, applied to a class of problems that don't lend themselves to traditional programming. In other words, they only lend themselves to learning.


he real impact in computers is not the silicon. It's not even the current software. It's the rethinking.

—Bob Frankston

Dick Shaffer: The idea of a computer learning from its environment I put about on a par with what I say about learning machines. Machines ought to come out of the box and do something useful. I don't want to have to send my computer to grade school. Programming is not teaching, and I don't want to confuse the two.

John Cocke: I don't think much of neural nets. I don't believe that that's going to be the answer to things.

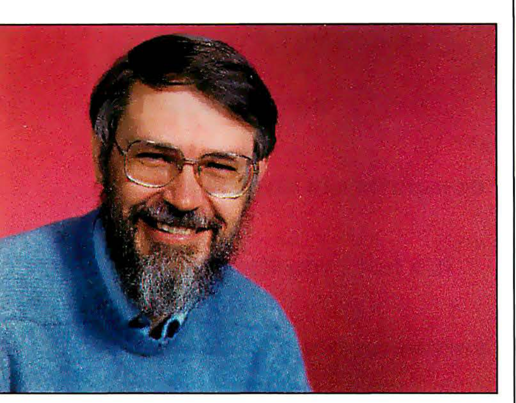
Ken Olsen: Oh, [neural networks are] something we love. I want to say yes, because we'd love to see it. It's a fascinating [subject] in the future. Good things come out of artificial intelligence, but not all of the things that are promised.

Stewart Alsop: I'm suspicious of things like parallel processing and neural networks. I'm a little bit suspicious of RISC computing. I guess I'd have to say I'm suspicious of things where I don't see the direct relationship between the technology and the result for the end user.

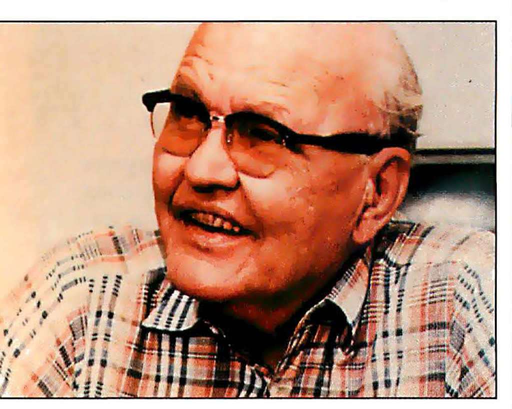
Terry Winograd: I think there are some interesting areas there. The notion [of] a huge industry there is false. I think they have potential, but different from what people think it is. I believe they are for niches like pattern recognition. I think they have long-term potential.

Robert Noyce: The areas I think are the

continued



Brian W. Kernighan is a member of the Computer Science Research Center at *AT&T Bell Laboratories.* With Dennis Ritchie, he coauthored *The C Programming Language,* which defines the C language.



Jack S. Kilby is currently an independent consultant. He and Robert Noyce are credited as independent coinventors of the integrated circuit. Kilby has been awarded more than 50 patents for his work in integrated circuits. Along with Noyce, Kilby received the first Charles Stark Draper prize from the National Academy of Engineering.

most interesting (and we'll probably look back on with pattern recognition) are the neural-net approaches to things. They will be extremely important. We will be solving the issue of doing tasks formerly better done by humans.

Danny Hillis: I think that people will be disappointed with how limited neural networks are in the short run. In the long run, I think the ideas of neural networks will get broadened out into other concepts, so I think it will lead to other stuff. I'm sort of a long-term optimist about that, even though I'm a short-term pessimist.

Federico Faggin: With neural networks, you will be able to build machines that combine both the traditional computational paradigm with this new computational paradigm. You will be able to solve problems from the traditional ones like speech recognition, all forms of image recognition, and so on, to even more important things [like] the application of very smart robots and autonomous intelligent machines.

John Caulfield: The ultimate application, without any question, in my mind is optical neural networks. Now, the trouble is, we know how to build them optically—we do not know what to do with them yet. They offer the hope of doing far more human-like activities than artificial intelligence. They are based on interconnections, and interconnections are the admitted great strength of optics. I can make more interconnections in and out of each neuron than can even biology. I could make a million things to each neuron optically; biologically, maybe 10,000 is what people think; and electronically, maybe 100. And so, the number of interconnections in and out of each neuron is much greater in biology than electronics, and much greater in optics than biology.

BYTE: ***What about fuzzy logic and chaos? And while we're at it, could someone please give us a definition for each of these terms?***

John Caulfield: I would say [the definition of fuzzy logic is] "precise operations with imprecise data," because the actual controls or decisions that you apply are always extremely well defined. It's obtaining non-fuzzy outputs from, or fairly certain outputs from, quite uncertain inputs. So, it's certainty-increasing operations—a nice way of putting it. How do we live with the fact that there is more than certainty involved and more than probability? Fuzziness is not probability. Fuzziness is real. Some things are inherently not well defined. My wife is a pretty lady. I think so, but there's no quantitative measure of that. Am I an old man or a young man at 54?

Paul Carroll: Fuzzy logic is important, but there's a whole lot of work still to be done on that. All you have to do is take a look at some of the systems that rely on that at the moment to realize how far that still has to go.

John Caulfield: It's now becoming quite clear that there's at least one area in which fuzzy things work, and work extremely well, and that's in controls. The Japanese are significantly ahead of us in applying these, and their experience has been extremely positive. They control everything from trains to elevators. The primary government organization in our country that seems to realize the need for fuzzy controls first is NASA, and the fuzzy-control thing that we are working on for NASA applications is docking. Docking—[as with] a satellite. Only fuzzy stuff that can predict with certainty is going to be important as fuzzy controls.

Steve Leininger: [But] if you're doing accounting software, you probably don't want a fuzzy network. You probably want good old BCD arithmetic, so you don't have round-off error, and all that. Maybe part of that is going to be speech recognition, and visual recognition, and all this kind of stuff. They haven't convinced me that they're quite on the right step yet.

Ken Sakamura: Nobody's going to make a mainstream computer based on, say, fuzzy logic. Of course, some companies are already demonstrating fuzzy-logic household appliances, and we'll see these technologies used on a piece-by-piece basis where appropriate, but not as major competitors to the main technologies.

Robert Noyce: Well, chaos and fuzzy logic are ways of life, so they will be with us and won't go away.

John Caulfield: My definition of chaos is "the production of detailed unpredictable results from highly well controlled and predictable circumstances." Well-defined equations producing detailed unpredictable outputs—production of things that are unpredictable in detail from simple, easily described inputs. It is not garbage in and garbage out. It is good stuff in, garbage out.

continued

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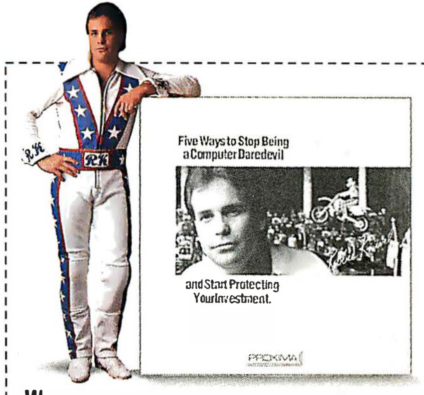
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It's that surprising aspect of chaos that's interesting. The other thing that is interesting is that what comes out and looks random, isn't completely random. The behavior is not predictable. This is the discovery of order. At a certain higher level, there is still order, even though it's of a disorderly type.

Bill Gates: Chaos—that's just a way of modeling things in physics. That doesn't impact computers.

John Caulfield: It is clear that chaos does, in fact, describe the real things that happen, and not just in the world at large, but in the technological world. Lasers and optical bistability and things like this often exhibit chaos. And lasers are useful in bistability issues. But is the chaotic nature of it useful? I'm not sure. I think it is too early to determine.

BYTE: ***So, basically, you're saying that these cutting-edge technologies are all things we can look for at some point in the not-too-distant future.***

John Markoff: The lesson that I've learned from that experience at Xerox PARC is, here is all this great technology in the mid-1970s, and there's an eight- or 10-year rule on diffusion. And so, everything happens about a decade after you think it's going to happen in terms of it reaching the mass market. And I think that probably holds true for a lot of these things.

Jonathan Sachs: I like sort of trailing-edge technology. I get interested in it after everyone [is done] arguing about it—the pioneers have already introduced the stuff and then I get interested in it. I try to engineer things to actually be real. That's the section of the industry I fall in more than the leading edge and the far-out stuff.

Jim Blinn: I don't think any of [these technologies] are going to be flashes in the pan. I think that anything that's being developed is going to have a following and a niche. Maybe I'm sticking my neck out on this, but I might say it anyway. I think the Macintosh will be a flash in the pan. I think that all the good ideas in the Macintosh, either those that Apple invented or that Apple subsumed from what Xerox invented, will have percolated out into other computers. But I think the Macintosh itself will fade away, primarily because of the fact that it is so closed and rigid. Technically, it's an OK machine, but you can do a lot better, and PCs are going to bypass it, I think. ■

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I N S I G H T S

Kemeny and Kurtz:

On BASIC

I think that there was an unfortunate start for BASIC in microcomputers. Earlier in this decade, it was implemented on really tiny microcomputers. It was a miracle they could implement anything, and I admire what they achieved, [but] I think some really bad versions of BASIC hit microcomputers.

I know when I first got an IBM PC, I loved the machine. But when I tried the BASIC that came with it, I was horrified. It was ugly and not at all [in] the spirit I thought BASIC should be. I think we've had an influence on that through the creation of True BASIC. I think our competitors have come out with much better versions [of their products]—I think under our influence. But I think that BASIC got enough bad publicity during that period that people have moved away from it.

I believe in two kinds of languages. When one really needs speed, one has to go to something like machine language, and I look at C as the modern version of machine language. So I can see writing some stuff in C, but [for] anything else, a language like BASIC—and I, of course, personally like BASIC. Good, structured BASIC, I think—and I know a lot of people at a lot of schools that feel the same way—is an excellent high-level language in which to [program]. And if in some parts of it you need extra speed, you switch to C.

In my experience, it is not the running time that is the overwhelming factor; it is the programming time that takes forever. And writing in a good, structured language just saves you enormous amounts on programming, and on finding bugs later on. ***—John Kemeny***

I see a future for BASIC for those people who are going to be doing FORTRAN-type programming problems but who want a language that has an easier user interface to it. I think BASIC is here to stay. Whether it will constitute more than whatever the market share is right now, I don't know. I don't know what the trend is going to be.

Anybody who has a personal computer probably has a bundled BASIC. This really includes practically all IBM PCs, which have some form of BASIC bundled with them. (Of course, that's the line-number version. I'm amazed that people write programs with that BASIC.) And I think the conversion from that version of BASIC to a more modern version will be very, very slow. There doesn't seem to be any forces that are pushing the market to make that conversion. That'll be slow, but one by one, people will feel more comfortable with BASIC.

The reason I say that is that for many people who have to learn—I'm talking now about people who do programming—there still seems to be pretty much a place for writing programs in the engineering and the technical fields. You're writing programs all the time, so you need a comfortable programming environment. And so for those people, it's really asking too much for them to use Pascal or C.

So I think that BASIC is here to stay. We're in the process right now—in the final stages of an ISO-standard BASIC. It's based upon the ANSI standard; it's the same language. Again, I don't know what the impact of that will be. If there are any vendors in the world that are planning to [support] standard BASIC, I don't know, because the people who use it don't constitute a strong marketplace. Educators—but they never spend any money.

What [Bill Gates] has done with his BASIC is to essentially turn it into Pascal. You've got a lot of the attributes of Pascal. You've got data typing; you can declare new data types. And true, if you can do that, you can get rid of some of the uglies that are a part of Pascal, and that's a sensible thing to do to a language that he wants as a systems programming language, an application programming language for applications on the DOS environment. So he can put anything he wants in, so that it will be especially targeted for that environment. And that seems reasonable.

We would love to do [that] to our language, to add things like data typing and record structures and so on, but we feel that it would mess it up so much that we'd lose the flavor of what we have. We're a different environment—we're a machine-independent language, so we cannot, [in] any appreciable way, put in features that are designed specifically to attack problems in the PC or the Mac. And it's perfectly clear that those two environments are completely different in terms of system development. That doesn't mean that you can't use True BASIC in those environments, but they have to be applications that don't require you [to] "bit twiddle" and don't require you to get at some specific hardware features. ***—Thomas Kurtz***

Editor's note:
See biography, page 270.

Jay Miner:

On Amigas in the Mainstream

It's the old question of which comes first, the chicken or the egg. Software people are not going to write good business programs for [the Amiga] as long as it's got the image of either a game machine or an artist's machine. When IBM first came out with their PC, they touted it as a business machine. At that time, the business programs on it were much worse than the ones that are on the Amiga now. Now, I think that's a very important point, because most of the Amiga business-type programs such as spreadsheets, word processors, and database managers are perfectly sufficient for 90 percent, 99 percent even, of small businesses around. Perfectly sufficient. And much easier to use and maintain than the ones on the IBM.

But unless Commodore starts targeting that market seriously, and calling it a business machine—which they are undermining their own possibility of doing every time they push it in other directions—unless they do that, the software developers are not going to do the software on it that they would like them to do. And that's where it's got to start. It's got to start with Commodore's marketing and advertising and how they image the machine, and how they get away from the image of the Amiga as a game machine, and, let's say, maybe artist's machine that it has now.

The [Amiga] 1000 was a compromise computer when it first came out, a compromise between the pressure mostly from me and my friends to make it more of a competitor for IBM in those early days and make it hit the business market, and the people, including the investors and Amiga, who wanted it to be a game machine.

Commodore has solved the compromise now, with the 500 as a low-cost machine for those who want it for the home to play games and do a little word processing on, and the 2000 series—[and now] the 3000—that is more of a real computer, like I wanted to build in the first place. The 2000 is the computer I wished I could have built back then.

They have gotten it right hardware-wise, I think. The 2000 is a good machine, hardware-wise. It's very expandable. It will even take the Bridge board, which will run IBM software in an Amiga window—which is handy if you want to run two things. You can run one thing on your Amiga and another on your IBM at the same time on the same screen. So, I think they have done it right hardware-wise, and I am very optimistic that they are about to do it right marketing-wise. Multimedia is a good name for a field that Amiga has been doing a lot of for a long time. I think having the supplied-with-the-machine authoring system is very important, very useful. But I wish they would target the business market and declare it a business machine and not a hypermedia artist's machine.

Editor's note:
See biography, page 296.

Bill Joy:

On the Next (Human) Generation

I think there are a lot of really bright kids who [have] had computers, not in the school, but at home. Kids [who] grew up with these machines and are very, very—not necessarily literate in the sense that they can read—but creative.

So, there's this new generation of kids that are growing up who have had computers in their environment and can imagine solutions using computers and things to do with computers that those of us who are at the ripe old age of 35 have a little more difficulty imagining. So, I think there is going to be this sort of shock wave of these kids coming into the industry. And I'm not sure the shock wave has quite hit yet.

Those kids are all going to go and be creative. And I hope they do great things that will benefit society as a whole by taking this technology and making it useful, because it is not going to be done by one or two people. It's not just Lotus 1-2-3 or a word processor that's going to make this difference.

These kids will hit the work force in large numbers sometime in the nineties. There will be a lag time, but there will suddenly be a rush of great new things that are happening. I think that will be a big change. I expect [it] in the next three to five years. You might call them "Apple kids" or "Mac generation." It will be interesting. And these are the kids that are going to write the great software of the nineties, whose names we don't know, who are just graduating from high school or college—the John Stuart Mills of the late twentieth century.

Editor's note:
See biography, page 262.

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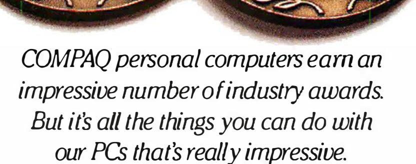
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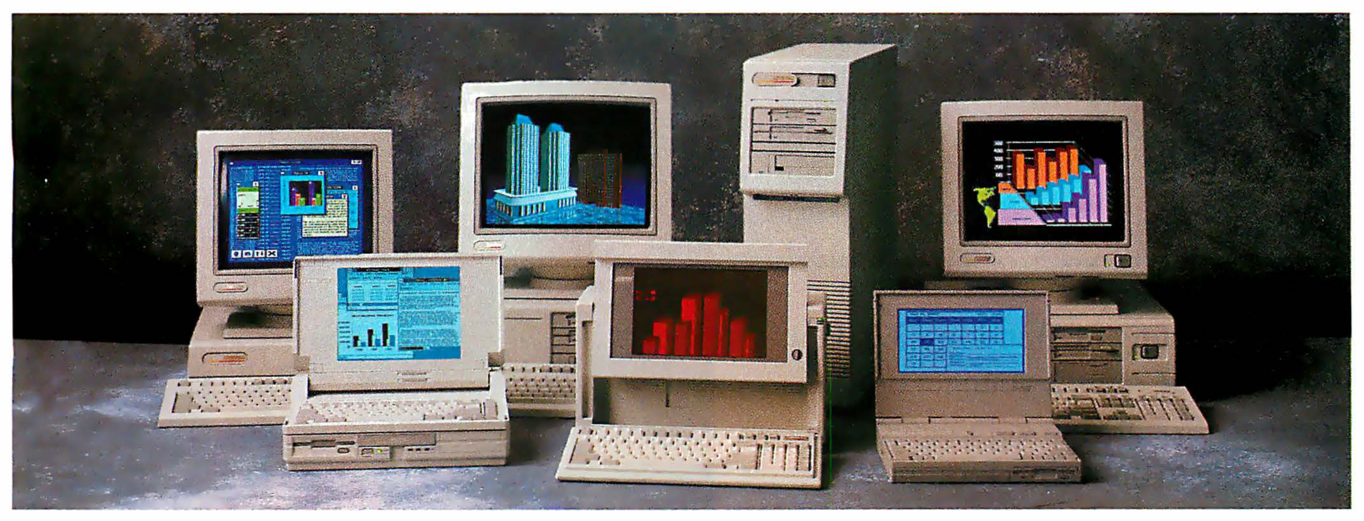


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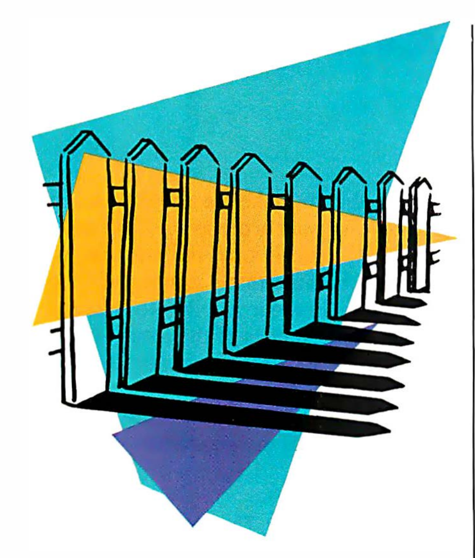


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What is the biggest obstacle to major new breakthroughs in computing?



The inertia of the whole PC market cannot be underestimated.

—Michael Slater

Tom McWilliams: I think that software development is the biggest obstacle we have. Programming languages today are fairly low-level. You look at things like C, FORTRAN, and so forth, [and] there's a tremendous amount of continually rewriting low-level code. I think that the thing we need to do to make the biggest advance in computing is to figure out more efficient ways of programming these machines.

Dennis Ritchie *(see biography, page 336)*: One of the basic criticisms that can be made of the [C] language is that it doesn't help much in doing large projects (i.e., it was not designed with big monolithic programs in mind). It was designed in an environment of multiple small programs that interact only by fairly restrictive means.

Jerry Pournelle: One of the biggest obstacles to the future of computing is C. C is the last attempt of the high priesthood to control the computing business. It's like the scribes and the Pharisees who did not want the masses to learn how to read and write.

Terry Winograd: I would say the big problems are more on the software side. We understand how to build things that go faster than we can use.

Jack Kilby: Well, my background, basically, is in hardware. And so that leads me to believe [that] any basic limitations are in software. I think in hardware, we can do most anything.

Bob Noyce: Oh, I think clearly software is where the action is. Not the hardware. I think again, we finally may go back to a new architecture. I think the major breakthroughs will have to be in software.

Dick Shaffer: Yes, software development. Hardware is the easy part. I don't see any major areas to increase power within machines. Machines will continue to get cheaper, faster, better, and the software gap will not only continue but it will get worse.

Michael Slater: More fundamentally, I think that the packaging and system design is a limit to the speed today. The chips themselves, running today at 40 and 50 MHz, and ECL chips running today at 70 and 80 MHz, and we'll see CMOS chips at 50, 60, 70 MHz before long. The packaging is a real problem today. There's on the order of 5, 6 nanoseconds essentially wasted in the delays associated with the pins of each individual package.

Alvy Ray Smith: I haven't heard of anything yet that limits them, so I don't see any reason why we won't see these speeds. And there are technologies lying in the wings for when the current ones run out of speed. I don't think that is going to be the problem. I think the problem is how we actually use them.

Andy Bechtolsheim: At the system level, you will have to package things much smaller and more carefully than before, because the limits of the speed of light really come into play at those kinds of frequencies, and people will probably use very advanced tab- or chip-on-board-type technologies to get the size of these machines way down.

Tony Hoare: I'm sure there is [a technological limit] around some corner. In fact, as a software man, I sometimes feel that I wish it would come sooner, because the increasing speed of the devices, first of all, detracts attention from the remainings. Look, it creates the illusion among the users that it's going to solve problems of complexity in software, and it's quite the reverse.

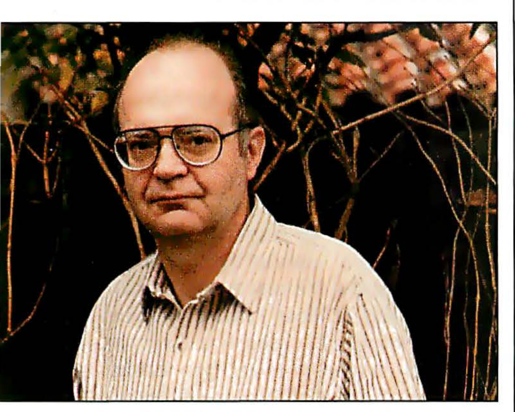
John Markoff: I think the pace of software development is going to continue to be the principal bottleneck. And that's because you can't manage the development of software in the same way that you can develop the management of hardware. I met with Charles Wang, who's the president of Computer Associates, and he said something that was very funny. He said when a software program is running behind schedule, what he does is he takes people off the project. In his view of software development as an art form, he looks for people who are good musicians and philosophers to develop the software as well as being good programmers. If it's an art form, then it is not subject to traditional engineering

continued

ILLUSTRATION: CATHARINE BENNETT



Gary Kildall is founder, chairman, and staff technical advisor at *Digital Research, Inc.* He created the CP/M operating system.



Donald E. Knuth is professor of the art of computer programming at *Stanford University.* He is the author of the renowned series *The Art of Computer Programming* and of the TEX typesetting language. Knuth received the A. M. Turing Award in 1974.

constraints. I don't think you can put hundreds and hundreds of people on a project and get anything but mushy software.

Dennis Ritchie: There clearly is a software crisis. Of course, there's always been a software crisis. We just don't know how to do big systems very well. It's not clear whether it could be fixed by fixing things at the small (i.e., better programming languages), or whether it's a matter of the design of the whole thing.

Paul Carroll: I very much believe that the biggest obstacle is software design. Software is at the point where the automobile was before Henry Ford came along, and there really is no Henry Ford or no assembly line in sight. I'd voice all the standard complaints: It's still too much artistry and not enough engineering; the tools still aren't adequate. The software developers need to really get out more and talk to the actual customers. Somebody also has to come up with some way of dealing with all the code that's already been written so that it's a bit easier to update it.

Mitch Kapor: There are three obstacles that I really worry about. The first is the time and expense of doing software development. It's still an incredibly labor-intensive process for skilled craftsmen. The equivalent of the assembly line for software just doesn't exist. A second obstacle to innovation and breakthroughs is the installed base drag. The more tens of millions of people you have using [a product], the less possible it is to do anything innovative, because [what] the customers want is refinements of existing stuff. A third obstacle is, I think, a lack of an adequate base of research funding from the government and the private sector. When the Japanese can spend $50,000,000 a year on a national initiative [for] interactive 3-D graphics or virtual reality, if you will—most of it private—we're not doing anything on that scale or like that. It's very sad.

BYTE: ***You mentioned the installed base. Does anyone else see that as an obstacle?***

Brit Hume: The installed base is of itself a major obstacle of a sort because of the need for compatibility. But I don't know how—it may be impossible to know for sure—how great an obstacle that is.

Stewart Alsop: There is a joke that people tell, and I'm not the source of it, so I don't want to take credit for it. It's a great joke, and the joke is that there is a reason that God was able to make the world in seven days, and that was because he didn't have an installed base. It's not the fact that we have users, because that's wonderful. The biggest obstacle is our inability to perceive what the opportunities of the future were. We built into existing equipment fundamental obstacles to implementing this new stuff. We have a tremendous amount of equipment installed that fundamentally cannot be upgraded.

Bjarne Stroustrup: The more acceptance that technology gets, the harder it is to change. If enough people are stuck at the same level, they think it's the truth. So emotion is there, and inertia is always building up. I'm not just talking about languages; I'm talking about operating systems, hardware architectures, etc. It takes a greater and greater effort.

Gordon Bell: The software [for the Intel platform] is like nothing we've ever seen before that has this inertia associated with it, because you put value on the software, you put so much value on your data. Some of it, I think, is valuable. Some of it isn't. A lot of times, I think people would be better throwing the whole damn thing off and starting over again.

Bjarne Stroustrup: My professor from Cambridge, David Wheeler, claimed that the time needed for an idea to come from the lab to be generally available had always been increasing. A couple of years ago, he claimed that the median delay was 15 years. By his law, it should be almost 20 years now. When things work, all the good aspects and the less good aspects mingle in a general inertia that makes it harder to change.

Alan Kay: So the biggest barrier is actually resistance to change. And McLuhan had this great quote. He said, "Innovation for the holders of conventional wisdom is not novelty, but annihilation." That's the biggest problem. Of course, the Japanese don't seem to be particularly threatened by novelty. They put it on like a suit, and it doesn't affect their identity.

Doug Engelbart: Our cultures evolved in given environments in which change was not a very large factor. It's only been, say, the last 100 years, and much less, even, for the really rapid change.

Danny Hillis: I think it's in the ability of the users to absorb change. I think that

continued

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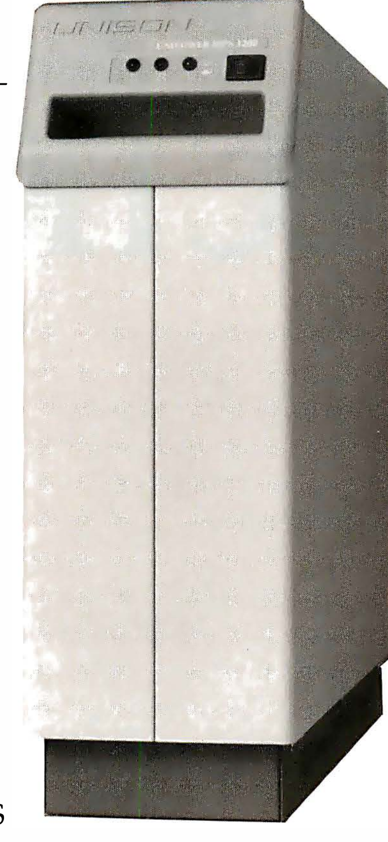
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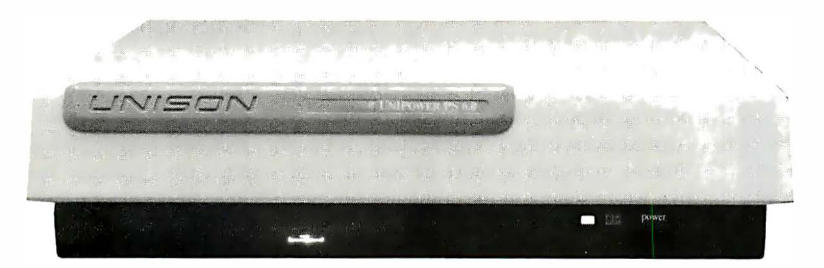
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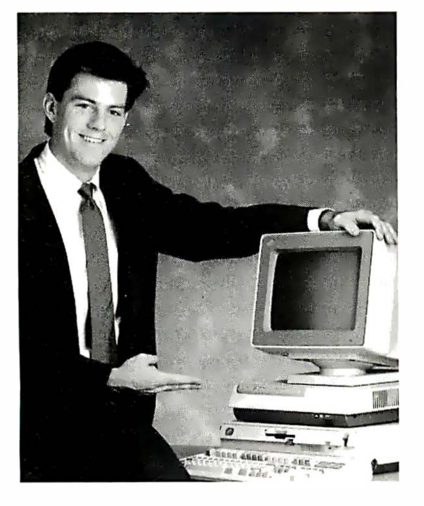
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Output Waveform	Sine Wave	Sine Wave	Sine Wave
Output Power	450VA/300W	600VA/400W	800VA/540W
Weight	28 lbs	33 lbs	37 lbs
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Support Time (286/386)			
Typical	10-20 min	15-20 min	15-20 min
Full Load	6 min	6 min	5 min
Cable & Interface Options	UNIX/XENIX, Novell, Banyan, 3Com, Altos		
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sometimes the technological possibilities have gotten tremendously ahead of the users' ability to put them to work. And I see that as the limiting factor in technology development.

Ken Olsen: There are major breakthroughs all the time. Unbelievable ones, you know. Computing changes so much. But almost nothing happens suddenly out of the sky. Almost everything is engineering. It takes time—sometimes a short period of time, like we're seeing in the computer business today.

Doug Engelbart: The biggest impediment is the perspective people have about what can be done, what's a candidate for change, how much value there'd be, how much change there's going to necessarily be. Some of the attitudes about change that I remember—well, if the computers are so smart, why should I change?

Dick Shaffer: The people are the factor. I don't think we will have any more brilliant programs, any faster, useful programs, any faster than we've got now. I don't know why we should expect the computer to be any more useful for creating computer programs than we expect it to be useful for creating novels or painting pictures. Software creation is just as hard as any other kind of creation. There's only a certain amount the tool can do, and it's not the most important part.

Bob Frankston: The biggest limitation is the failure of imagination that people tend to project. Actually, the biggest obstacle is marketing surveys, is people projecting from what we have now, the people trying to meet felt needs. It's the unfelt needs that are always the exciting ones. You've got to have a leap of imagination, and the biggest obstacle is change of paradigm. The real impact in computers is not the silicon. It's not even the current software. It's the rethinking.

Rich Malloy: People get used to doing something in a certain way and have a great deal of difficulty trying to do something different, even though it's better. It has to be much, much better to get people to change products. Getting people to break out of their traditional ways of doing things may be more of a problem than getting them to use computers in the first place.

Nicholas Negroponte: I think it's people. I think that the breakthroughs we're going to see in the next decade will come from applications—they're not going to come from fundamental material science. Really, applications are going to push most of the breakthroughs.

Steve Leininger: I think that one of the things that's going to limit progress is that to do something new now basically requires a corporate commitment. You are talking about serious design dollars—serious cash outlays. So, a lot of the innovative stuff isn't going to be accidently designed in a garage anymore.

Lee Felsenstein: The high cost of capital in the U.S. has resulted in significant distortions of the development process. Venture capitalists require a 20-to-1 payback in a few years or else they'll can you, ditch the project. When you have that kind of evolutionary imperative going on, everybody goes to work on what is supposed to be really high paying-off projects. And all the projects that will pay off reasonably well over a reasonable period of time, die. As a result, we have evolved the industry into a real Las Vegas scene: Everybody is walking around talking big and doing nothing but gambling.

BYTE: ***Will the relationship between hardware and software change in the 1990s?***

Michael Slater: I think it will change, to some degree. What the software industry has had to struggle through in the last five to 10 years are rapidly evolving microprocessor architectures. You look back where we were 10 years ago with the 8086 architecture, and then having gone through the 286, and on to the 386. The 8086 architecture really was not adequate for developing sophisticated software. It did not have enough addressing range. It had the segmented address scheme. Then the 286 imposed a memory management scheme that was fundamentally ill-conceived. Now that the industry is moving on to the 386 architecture, I think you won't see that same sort of painful discontinuity introduced, in that the 386 architecture, I believe, can last (from the software point of view) for another decade. The 486, for example, implements really the same architecture as the 386.

Tom Kurtz *(see page 270)*: The hardware vendors are not going to stop inventing better and better hardware. They're getting involved with distributed stuff—it's even more complicated. Most of the applications that are written now are monoprocessor applications. They're not designed to serve

as the headquarters for a distributed application.

Jonathan Sachs: But what's happening, interestingly, even now, [is that] the hardware technology is already pretty firmly in the next generation beyond what anyone is using in PCs now, with some of the RISC chips and Intel i860 and MIPS and Motorola 96002. None of these chips will run any of the existing software that we have now. If this were 1980, then those chips might very well form the backbone of PCs going forward. But this is 1990, and there are 10 years of 68000s and 8086s out there, and an applications buffer that's built up, and operating systems and everything else. I think we are getting into a situation where the hardware is going to get pretty far out in front of the software—much more than it is now.

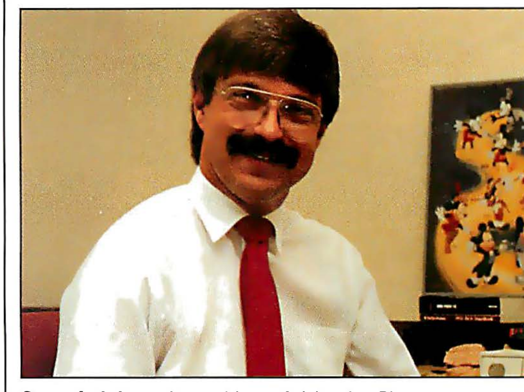
Rod Canion: I think what we're seeing now is the hardware changing at such a rapid pace that we're going to be in an era where software is the pacing item for some period of time. I just think that operating systems, Windows 3, OS/2 for the 386, and the applications that take advantage of those—those are going to be years in the making, and the hardware is going to continue advancing at a rapid rate in the meantime. So, we're going to see hardware out in front of software for quite a while.

David Evans: Well, we do know some little things. We know that some of the things we have done in software are simply too slow, too weak, or whatever. It's a moving boundary, and these functions perform, and you have to decide how to do it. The tools that are being used for designing chips, for example, are very much patterned after the software tools.

Tony Hoare: We will see quite clearly that the same kind of errors and confusions that arise in the software field could very easily be reproduced in the hardware development field when the complexity of the hardware begins to rival that of the software.

Gordon Bell: I guess I don't see much of a

continued



Steve Leininger is president of *Adaptive Plus.* He was the inventor of the TRS-80 and chief architect of Tandy's Model II, Model III, and Color Computer. He is also involved in the Center for Computer Assistance to the Disabled.



Rich Malloy is editor in chief of *BYTEWEEK*, a newsletter covering the personal computer industry, and associate managing editor of *BYTE*, where he directs the news department.

R. MALLOY PHOTO: DAWN MATTHEWS

The biggest barrier is resistance to change.

—Alan Kay

change. I think software people have gotten really quite independent of hardware at this point, and they are off in their world. And the bulk of the software is not going to change much at all, to sort of buffet where there's a lot of change required when you work on these parallel machines. Why, then there is some interaction. You need that separation so that they can both evolve quite independently.

Doug Engelbart: I think [software's] going to get more and more important.

Carma McClure *(see page 292)*: Yes, I think software is going to start catching up, and I think there are lots of reasons for that. First of all, CASE brought it on and started the whole thing, and now, we have hardware vendors interested in developing software tools, and so we have the momentum, the money, the recognition, and the technology that we never had before to support it. Also, artificial intelligence techniques are now a little easier and more practical to use and embed in our tools. So I think you are going to see some changes, but first of all, we have to attack the integration problems, building integrated tool environments, and an important segment of that is the issue surrounding repositories.

Brian Kernighan: I think that in some ways the thing that's likely to change computing is somebody's got a better software idea. For example, you couldn't have windows on your screen very effectively until you had a fairly high-resolution screen, and then you could start to think about windows. And you couldn't utilize things until you had enough memory, and so it's clear that the hardware and the software drive each other. ■

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Alvy Ray Smith:

On Graphics in the 1990s

What does it mean to be able to talk with pictures, instead of words? I think that's what people want to do. I think it's the natural form, the widest bandwidth implementation. So far, computers have been highly constrained in making pictures. The reason they have been highly constrained is real simple: They just haven't had the horsepower. The revolution that is happening, starting now, will be wide open by the year 2000 when that horsepower has finally arrived on the desktop. This is easy for me to see, the year 2000—all the professional-quality images we'll be handing each other, as casually as we hand PostScript-printed black-and-white pages to each other today.

What has to be put in place is the story of the nineties. PostScript is a good example of a piece of the infrastructure of computing that got put in place to handle black-and-white, geometry-based picture making. What remains to be put in place? Well, there has to be a 3-D, full-color infrastructure put in place. Of course, Pixar's RenderMan is a piece of that infrastructure. [It is] to color and 3-D what PostScript is to black and white and 2-D. And that's on the geometry side of things. And somewhere another piece of infrastructure that is going to be put in place is the color standard, so that people can wheel and deal color and get the same color out on all the different output devices that exist now, and will exist in the year 2000. It's a very difficult problem, but it will be solved within the next few years. That will be in place by the year 2000. (When I say infrastructure—I guess that's an OK word—what I mean by that is what you get on your desktop when you buy a machine, stuff that's assumed to be there, that you don't have to go out and buy—part of the basic stuff that you buy when you buy a computer in the year 2000.)

When I look at the desktop marketplace right now, the big gaping hole of applications, the big missing set of applications, are those that deal with color. And I mean real color. Photography, color printing, full-color presentations, video production, full multimedia production, film production, [and so forth]. I think a lot sooner than 2000, but they will be strongly in place.

It's hard to see it right now. It is still fairly difficult to do full-color pictures, single pictures, but when you have 1000 MIPS—wow! You can start doing real-time image rotations. I don't mean simple, several-thousand-line polygon images, I mean several million sample-point—full-color, each sample point. You'll be able to rotate those things, drawing into perspective, or rescale them without loss of quality in real time.

I've seen all the work, but I still can't believe we'll be able to do that in no time on our desktop computer software by the year 2000. But that's what we'll be able to do. So, it will be easy to do pictures, movies. That's what I'm trying to say, that those things will all be possible by the year 2000. What is hard to predict is how that's going to change how we deal with each other. I think it is going to have a massive impact on everything.

The key thing—concept—that will describe how people will deal with pictures is spatial editing. What does that mean? What we mean by the word *editing* in film and video is the placement of segments of film or video in time. An artist called an editor comes in and arranges the sequences in time. [The] big change in the next decade will be that the same freedom will be granted, hopefully, to arrange things in the space of a picture.

I don't know if you have ever tried to model a 3-D picture, but it's very hard. So, one of the class of applications that there is going to be a lot of [is] modelers. But I think what is going to happen [is,] instead of handing people over the modeling process, we'll hand over models to them. In other words, the marketplace will be catalogs of premodeled objects or predescribed textures. Instead of me, as the user, having to sit down—I've got this desk in front of me, my books, telephone, paper—instead of having to model each one of those things in order to [create] a picture of it, I would just take the catalog, an electronic catalog, off the shelf here, plug it into my desktop computer, and pick off that particular lamp and that particular set of books. The stuff is already done. I, as a spatial editor, can go in and place those objects in my [rendering] at my discretion. I can change their relative sizes, and I can change the colors maybe, and I can map different appearances onto their surfaces, customize their look. But my job as a picture maker will be more like editing than constructing.

I'm just convinced that that's the future that we'll see unfold here. What I am describing is the RGB full-color marketplace of the nineties. There will be a host of companies that are required to make products available to fill this market up.

Editor's note:
See biography, page 352.

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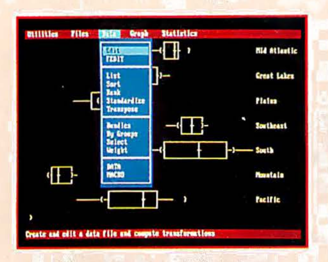


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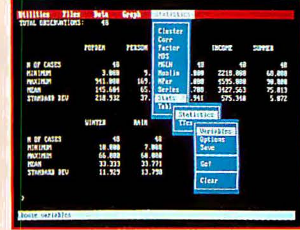


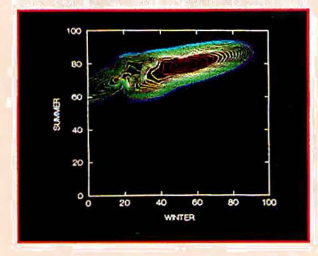
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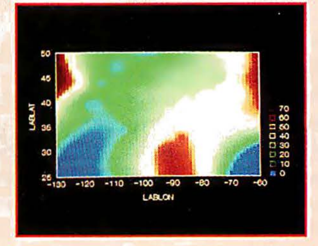


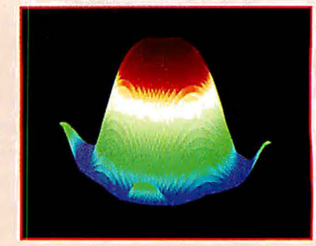












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Statistics Basic statistics, frequencies, *t*-tests, post-hoc tests ▪ Multi way crosstabs with log-linear modeling, association coefficients, PRE statistics, Mantel-Haenszel, asymptotic standard errors ▪ Nonparametric statistics (sign, runs, Wilcoxon, Kruskal-Wallis, Friedman two-way ANOVA, Mann-Whitney U, Kolmogorov-Smirnov, Lilliefors, Kendall coefficient of concordance) ▪ Pairwise/listwise deletion of missing values, Pearson correlation, SSCP, covariance, Spearman, Gamma, Kendall Tau, Euclidean distances, binary similarities ▪ Linear, polynomial, multiple, stepwise, weighted regression with extended diagnostics ▪ Multivariate general linear model includes multi way ANOVA, ANCOVA, MANOVA, repeated measures, canonical correlation ▪ Principal components, factor analysis, rotations, components scores ▪ Multidimensional scaling ▪ Multiple and canonical discriminant analysis, Bayesian classification ▪ Cluster analysis (hierarchical, single, average, complete, median, centroid linkage, k-means, cases, variables) ▪ Time series (smoothers, exponential smoothing, seasonal and nonseasonal ARIMA, ACF, PACF, CCF, transformations, Fourier analysis) ▪ Nonlinear estimation (nonlinear regression, maximum likelihood estimation, and more).

Graphics Overlay plots ▪ Drivers for most graphics devices ▪ *Two-dimensional:* Error bars ▪ Scatterplots ▪ Line and vector graphs ▪ Vector, dot, bubble and quantile plots ▪ Bar graphs (single, multiple, stacked, range) ▪ Box plots (single and grouped) ▪ Stem-and-leaf diagrams ▪ Linear, quadratic, step, spline, polynomial, LOWESS, exponential smoothing ▪ Confidence intervals and ellipses (any alpha value) ▪ Smooth mathematical functions ▪ Rectangular or polar coordinates ▪ Log and power scales ▪ ANOVA interaction plots ▪ Histograms (regular, cumulative, fuzzy) ▪ Stripe and jitter plots ▪ Gaussian histogram smoothing ▪ Scatterplot matrices ▪ Voronoi tesselations ▪ Minimum spanning tree ▪ Maps with geographic projections (U.S. state boundary file included, county and world boundary files available) ▪ Chernoff faces ▪ Star plots ▪ Fourier plots ▪ Pie charts ▪ Contour plots on regularly and irregularly spaced points ▪ Control charts and limits ▪ *Three-dimensional:* Data plots ▪ Smooth function plots ▪ Vector plots ▪ Linear, quadratic, spline, least squares surface smoothing ▪ Typefaces that print in perspective.

Data Management Import/export Lotus, dBase, and DIF files ▪ Full screen data editor ▪ Full screen text editor ▪ Unlimited cases ▪ Missing data, arrays, character variables ▪ Capability to process hierarchical, rectangular or triangular files, irregular length records ▪ Character, numeric, and nested sorts ▪ Merge and append large files ▪ Unlimited numeric and character variable transformations ▪ Subgroup processing with SELECT and BY ▪ Value labels and RECODE statements ▪ Macro processor with programming language, screen control, file manipulation, applications generation, and report writing.

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eople say that standards stifle innovation, and in communications, that's not true. Standards enable communications.

—John Warnock

THE BYTE SUMMIT
POWER PLAYS

What do you think of the reassertion of power by data-processing and MIS departments?

Stewart Alsop: It infuriates me. Somehow, the notion goes, in order to implement these new technologies that have multimedia and effective networking and groupware and host connectivity and buzzword, buzzword, buzzword, we have to have more complex computer systems. And if we're going to have complex computer systems, then we have to get DP and MIS back into the loop, because they understand this stuff, and those "poor dumb users" don't. And the "poor dumb users" are going to screw up the computers. So we need DP and MIS to protect the computers from those "poor dumb end users." And it's like, what year is this? Back to the Future, Part 15.

Steve Leininger: To me, I think some of that control is just sort of natural. I don't think people who've been in charge of just the small microclusters or the stand-alones have been necessarily responsive to the needs of a much greater organization. So, I guess I think it's OK.

Jerry Pournelle: It's negative, and it won't happen. It won't last. You may remember that Pournelle's Law [is] one user, at least one computer. That was Pournelle's First Law.

Jim Blinn: One of the nice things I find about the PC environment, one of my fundamental philosophies of life, is [that] I don't like concentrations of power—anywhere, for any purpose. And the fact [that] the PCs are very generic and spread the power out, I think is good. Any sort of organization that tries to coalesce it in one place, I'm not too happy about.

Jonathan Titus: You know, maybe I'm completely wrong. Maybe the idea of bigger servers is the way things are going to go, but I think if you look at things traditionally, you find that large things tend to fragment rather than to coalesce. I think that's what will happen with the large concentrations of computer power within companies.

Tom McWilliams: I think that there is a very strong role for larger machines to support machines on the desktop. I see the machines on the desktop replacing the traditional dumb terminal with very intelligent boxes that provide [a] very good user interface and do local computing for jobs that sit on those machines.

John Markoff: In my company, I really see the struggle going on. There's a tremendous amount of tension that's a direct consequence of this sort of clash of the mainframe view of the world versus the desktop view. And clearly, one of the consequences of networks is that there will be a reassertion of centralized control. But I think that there are certain aspects to personal computer technology that are just genies out of the bottle and they're never going to be able to put it back. There are some companies now, there seems to be a trend to actually do away with MIS: Some places here in NYC, there are no more MIS departments. Some companies in the Valley have done away with mainframes and are going to entirely distributed computing models. There's more freedom.

Bill Stallings: I think there is a flavor of trying to hold all the strands together from a central location so that you have cooperative computing—but, at the same time, not centralizing procurement or even all the ownership of data, because that tends to inhibit things, and particularly in the micro area. [You need a] true distributed system that is integrated. There's sort of a tension there of trying to balance central planning and central integration—distributed cooperation—and the thing that allows this sort of a balancing act is the standards.

Jonathan Titus: Well, I think we're seeing, these days, actually a fragmentation of service departments like that. And we'll continue to see it. I think the reemergence has come only because we're finding we need network servers, and the network servers tend to be controlled by the MIS departments because they're a big box and they're connected into a lot of different places.

BYTE: ***How do you think it will affect the microcomputer users and their companies?***

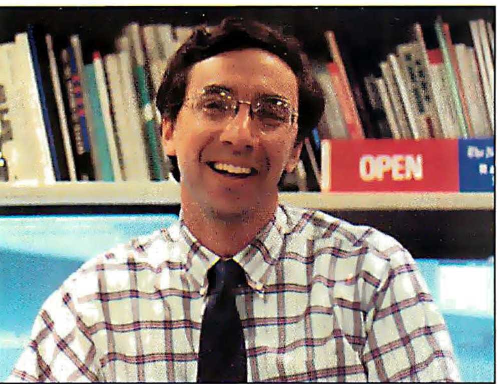
Terry Winograd: Stand-alone computing

continued

ILLUSTRATION: CATHARINE BENNETT



Jim P. Manzi is president and CEO of *Lotus Development Corp.*, where he directs corporate strategy and the overall operation of the company.



John Markoff is a reporter for the *New York Times*, where he covers computers and technology. Markoff has also been a West Coast technical editor for BYTE.



Carma L. McClure is an independent author, lecturer, and consultant specializing in software methodologies, tools, and law and project management. She is a leading authority on CASE.

will get more limited. I think networking is inevitable.

Steve Leininger: As long as you don't hook yourself onto the network, you're OK.

Tom McWilliams: I don't actually see that larger central machines are at odds with machines on desktops. I think that you need both.

Dennis Ritchie: One of the aspects of any kind of PC, using it as the generic term, is that this is a box that you own. You may not understand everything that goes on inside it, but, in some sense, you have control over it. Whereas, if you're dealing with a computer center or an MIS department, there's a definite lack of control. The other side of that is that as systems get more sophisticated, the amount of work involved just to do your own administration is increasing, and things are getting more complicated. They're getting harder to understand. You have to understand more in order to use them effectively.

Jonathan Titus: I hope it has as little effect on the end user as possible. In effect, they may not even know where their server is, or specifically what's in it. And I think, too, that the computers will become so powerful that the idea of a central server may, in fact, disappear. It may be, with all these computers linked together, one is a controller but bits and pieces of what I'm working on may be stored across a lot of the different systems in the network.

Tony Hoare: I think it's a sad step because, again, it gives you an advice and consultancy bottleneck where people can't do what they want until they can get the attention of an expert who will tell them how they can do it. The promising sign for the personal computer is that people can develop their own application and then perhaps integrate later as the need for it becomes apparent. And that has tended, I think, to break down the centralized power structure of data-processing departments, which can be a significant barrier to progress—particularly when, in these very progressive times, things are changing so rapidly.

Jim Manzi: But fundamentally, all [that the users] want to do is get data, do something with the data, share it with somebody, and send it off, and get it updated. And a forward-thinking IS manager wants the same thing to happen, because the concept of end-user computing is obviously proven. I view it less as a conflict and more as a conversion.

Ken Olsen: Oh, I think it's very good and very important. Having a bunch of people using their own microcomputers is obviously unwise if they do the wrong thing. And they have no communication with the world. The things you do most of the times in the office involve everybody else. Almost anything you do should be integrated.

Dick Pick: It's going to have to come. The point is, if you're going to run an organization that uses computers, you've got to have some centralization to it. I have the same problem. I've got the equivalent of an MIS department, [but] it's only one person. You've got to have somebody who takes ownership of the corporate database, and that traditionally has been the MIS department. I don't see how else they're going to tie all these PCs back together into a corporate tool as opposed to a personal tool.

Steve Leininger: What made the personal computer great is the apparent speed of having all that horsepower dedicated just to you, for word processing or other data manipulation. If you're talking about a big company, they can't afford to have the information that runs the company—today's inventory, this kind of stuff—scattered all over the place.

Dick Shaffer: I think it's essential for large organizations. As the computer becomes more important to companies, you have to have some kind of control over it.

Charles Simonyi: Actually, I think that it is a good thing. I think what really is happening is the embracing of the computer by the MIS people as more than a control. You can't control the personal use of computers. I don't think there is any issue there.

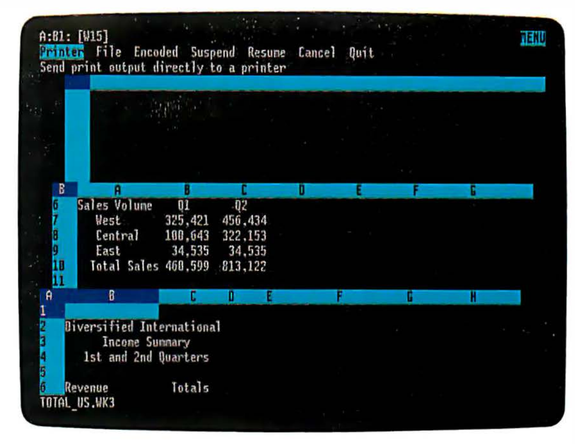
BYTE: ***Is this a positive move or a negative one?***

Gordon Bell: It's only negative if it starts impeding things. I don't think it's going to do that. I don't think they can. There's no way that they can get in the way of progress. I mean, just maintaining the network I don't think is any more harmful than the fact that in every company you have a telephone czar taking care of the telephone. I don't see that as any different. What gets harmful is when you rule out certain kinds of machines.

Paul Carroll: It has positive and negative

continued





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1989—BYTE

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PC User (UK)

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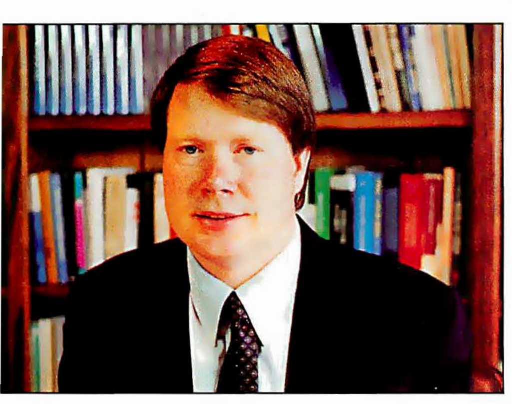
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Thomas M. McWilliams is a vice president at *Amdahl Corp.* He is a pioneer in the design and development of computer-aided engineering systems.

attributes. It's very important for companies to be able to hook all these machines together in a network, and somebody's got to do it, so it might as well be the MIS types. More and more, the business types will become involved in the development of applications for their computers and in the use of the computers. And I view that as very much a positive development.

Doug Engelbart: Somebody in the organization needs to start being responsible for the larger system, of harnessing the capabilities of this. So, if not the DP/MIS people, who?

Lee Felsenstein: [I agree.] Somebody has to take that role. It would be nice to develop networks that can be self-managing. That, in microcosm, is really the problem [that] we've got with industrial society as a whole: working out those technologies—using a broad sense of technology—through the operation of which it becomes sort of natural as to how to organize things.

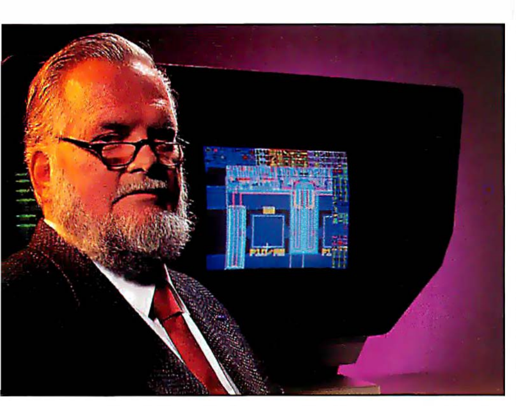


I contend that the purpose of computers is human freedom.

—Ted Nelson

Ted Nelson: Corporations legitimately want to standardize and regulate, in a sensible fashion, the use of personal computers and especially databases throughout their corporations. However, more illicitly, what is also happening is that data-processing managers are fighting back, trying to recapture lost territory; trying to keep the mainframe necessary is the hub of this, and trying to become the sovereigns once again. This is quite unfortunate, and I don't think it will be that sweeping. But who knows

continued



Jay Miner designs medical instrumentation for *Ventritex, Inc.* He was principal designer of the Amiga computer and creator of the Amiga custom chip set. He also designed the chip sets for the Atari VCS and the Atari 400 and 800 computers.

J. MINER PHOTO: MEL LINDSTROM

politically? Politically, many different things can happen.

Carma McClure: I think you might find that everybody goes off on their own and then they say "wait a minute, wait a minute. We are stepping on one another's toes here, we're not doing what we should be doing, and so let's get back together and have some sort of control and management." So I think that it will go full circle like that.

Rod Canion: I think it's a necessary thing. What we saw was a pendulum swinging from one extreme to the other, [from] where MIS had all the power to the point where the users themselves had basically almost all the power. The unifying force is the networking of PCs and workstations together [so] that no longer can an individual really take full advantage of his PC by himself. He needs to have other people involved. So you need a group like MIS. I think what we're going to see in the next several years is a medium being reached—a balance being reached between the user community and MIS working together to solve these problems.

Wayne Ratliff: There are positives and negatives to it. Yes, I do see it happening, and neither side is going to gain control, I don't think. The microcomputer people are the ones who dared move away from the mainframes. And they thought it was an exciting environment. So, we have this little pendulum effect going in the computer business—it will swing back and forth forever probably.

John Warnock: I think all of these sociological changes in the industrial portion of our society go in cycles. There's sort of a centralization, decentralization, centralization, decentralization—and as far as I can see, in the computer business, I've seen about three of these cycles. I don't see any reason to see that stop. You need to have a more global view of this and say, "Hey, that's a behavior of that overall social system and not something that has any long-term effect." You just have to ride the current trend. ■

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Ted Nelson:

On the Xanadu Project

The issue [that] most deeply concerned me was the problem of the total arbitrariness of writing, and how in the world you decide among and work out the details of different forms of organization of a document. Then I took a computer course, and it was like being struck by lightning. I came up with the following five realizations. (We're talking October of 1960.)

1. The computer screen would be mankind's new home.
2. We would have new forms of documents and new literary genre—which I did not yet call hypertext—which would be nonsequential writings because we would no longer be constrained to the sequential organization of text. Therefore, the arbitrariness of sequential organization could be thrown away. The reader would be free to explore, and conversely, the author would be freed from the problems of unnecessary, superfluous, gratuitous organization. In other words, deciding which comes first (over which we have to make so much effort) is totally unnecessary when neither part comes first.
3. This would be the heart of an entire new literature [that] would subsume all of the literature of the past; that is, all of the writings, all of the ideas from before, and everything that was published on paper would again be published in electronic form. But, as nonsequential organization took over, all of the pieces could be reused in new ways.
4. This would require a worldwide delivery network, which would be a network of computers.
5. [The delivery system] would be franchised.

And the amazing thing is that this vision is coming about, essentially all five points, as I foresaw them 30 years ago.

Now being completed 30 years later [is] the program for what I thought of as a writer's console. But remember that, since I consider writing the king of the problems, the most intricate type of mental endeavor bringing to bear all the arbitrariness of every type of decision, I took this to be the model for every other hard problem; decisions facing heads of corporations and heads of state seemed to be trivial by comparison. Of course, that was a writer's perspective.

The most important thing I needed in the software does not exist yet. And one of the reasons I'm so pissed off at the entire computer world is that they have not understood what I consider to be essentially the most fundamental problem, and that is what I call *transclusion*.

Transclusion means that a thing can be in two places at once. Suppose you write a sentence you like, or there's a paragraph that needs to be quoted from one document to another. [Copying it] loses the connection—the thread that ties them together. But in transclusion, you make a virtual copy from one place into the other so that there is a hole in one place that you wanted [the sentence], which is filled always from the other place whenever you get to the hole. The Xanadu system [that] we're working on here at Autodesk is based on transclusion.

Transclusion in Action

As you consider the organization of something--Where are you going to use this piece? Are you going to use it in document A or document B?—as soon as you decide not to use it in document A, that frees it up for document B. But if you are still undecided, then you want it in both places and you want to be notified when it is [used]. And in deciding to use it in one, you want to see what its status is in the others. That's one use for transclusion. And that was fundamental to my first design—transclusion and fragments.

Secondly, I want to get to keep a continuous journal and be able to transclude all the fragments into all the potential projects where they should go, and then be able to see side by side all the potential places I would want to use them. Then as soon as one [fragment] was used, or you decide not to use it somewhere else, then it's freed up.

You [also] want to be able to compare different successor versions of the same document—to see if this one is better than that—or different alternative designs for the same document. And in that case, you want all the "meat" material in one—all the material that's in both designs for the document—to be transcluded back and forth so you can look at this organization in two or more different ways.

The third use of transclusion is for electronic publishing, because it basically solves a lot of the copyright problem if you have a network in which things are stored, a repository network for publishing, and that's the other part of what we're working on. And remember, I talked about the great network. So this software would be the fundament of this great network and this repository network for publishing.

All you have to do is publish; you publish a document by placing it in the repository and saying "I hereby publish it." That means I'm responsible for the contents. You pay a registration fee; the publisher pays a registration fee and a storage fee and then gets royalties back automatically every time fragments are sent out.

But the trick is, how does transclusion fit in? It cleans up the whole issue of copyright permissions, because now that it's in a repository, you can quote anyone else freely without asking their permission. Why? Because you are just transcluding material. You're leaving holes in your material to be filled from these other documents at the time of delivery to the person's screen, which means that the customer is buying the fragments from the original author whenever those quotations are read. So, nothing is misquoted, nothing is out of context, credit is apportioned correctly, and royalties are apportioned correctly.

So to me, the basic piece of software is a transclusive fragment sorter where

you sit with thousands of little flips of sticky notes, and you sort them into different projects with transclusion, so that any sticky note can mean any number of things. A file card—whatever you want to call it—can be in any number of places at once, with an umbilical cord connecting all the instances.

The Xanadu Server

So, this project has never at any time been inactive as far as I'm concerned, and it has always proceeded toward the system we are working on [and] are about to bring out.

I contend that the purpose of computers is human freedom. And the better world we must have will be one in which computers make life simpler, not harder, allow us to tie together our work and have control of it, and bring us clarifying overviews and understanding of everything we see and do. Whereas right now, computers are still quite the opposite.

Imagine, if you will, the year 2020, when a billion people around the planet are at their screens. And each is able to withdraw from a great repository any fragments of anything that has been published, as well as the private documents he or she has access to. So, you're able to bring to your screen not just encyclopedias, not just novels, not just the works of Horace and Cicero and Marcus Aurelius and Shakespeare and Goethe, but obscure stuff from South America and Africa that people have written in the last 5 minutes. And [you're able] to make comments and footnotes and to transclude and quote from anything else that's published, with automatic royalty.

So, I was talking about the year 2020, the 2020 vision. The question is, how we get there from here? Well, it's very specific in my plans. Autodesk and Xanadu Operating Company, which is now a subsidiary of Autodesk, will be bringing out the Xanadu Server, which will be, I believe, the new paradigm for the storage of information because it has links and transclusion built right in. It will replace the file model, and we will redesign all software around this model, because this has been the correct model all along. Just because people have insisted on doing things stupidly the last 30 years doesn't mean that they can't finally get the idea.

People can understand things they see. I know. I've come to realize it. The next generation of software will be built around the transclusive model of data handling, which opens up all your data in every direction and allows you to represent the true interconnection of the information within it. Right now, there is no good way of representing interconnection. We have trivial linking systems in the smaller hypertext systems. But Xanadu has a truly general linking system with an open-ended and very powerful linking structure, as well as transclusion. And so, because it will allow the exact representation of all interconnections, Xanadu seems to me the shoo-in for becoming the standard for data storage in the future. And since it's built around the concept of networking, and access of many people to the same data, it then leads to the publishing system.

The back-end server will be coming out next year, as I say, from Xanadu Operating Company, and that will run on the Sun, the Macintosh, and the larger PCs—the 386s. This will hit on the LAN and serve as many people at once with the fragments necessary to support their documents. You see, up till now, we've had this dumb model where you store a whole document, then you go in and change one word, and then you store the whole document again. What sense does that make? What you want to do is store the changes or have a rational means of keeping track of the current state of the document without re-storing the entire book to change one word.

Being able to treat [stored data] as a seamless interconnected whole is absolutely vital, and this is what a truly generalized link server will allow. So, all of this will be within our grasp or will be reachable when the back-end server gives us a chance to build new applications around these forms of interconnection.

Two years later, we need only two more steps to go from the back-end server, as Xanadu Operating Company will be delivering it, and the worldwide publishing network of which I spoke. And these steps essentially involve the addition of the internetwork protocol and the addition of the royalty mechanism. So this ought to be doable within two years.

Transclusion Tomorrow

The plan is to open the franchise first in northern California, for a chain of McDonald's-like information stands, which will form a repository network. You'll be able to put your private documents in, and thus it will be a mini-self-storage system for information, just as you go to a mini-self-storage place to put your sofa and your old TV where you can get at it.

When we go to the publishing system, all you do is press the publish button, and whatever data you wish to publish [is] published in this universal linking and transclusive data structure with automatic royalty. And this, too, will be offered at the Xanadu stands. The user comes into the stand to learn how to use the system and to start up an account. So rather than learn the system out of a manual or from some class, you come into a McDonald's-like atmosphere where a person will sit down and show you how to use the system.

Now you take your account and your software home and fire it up from home and modem in. You can modem in to any of the Xanadu staff or connect through other networks.

Editor's note:
See biography, page 304.

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I don't know if it's computer literacy that's going to stratify [society] so much as it is just economics.

—Jim Blinn

To what extent will computer literacy stratify society in the 1990s?

Charles Simonyi: That is an interesting question. I believe that computers are a very positive force, and computer literacy endows the literate person with some added powers. And, just like literacy, it makes the person more powerful. Of course, it is possible to view any sort of power as something that distinguishes people that have it [from those who] don't have it.

Rod Canion: I think that's not something that's going to happen. I think there's some of that today, but it probably won't get any worse than it is today. I think during the decade we're going to see computers become easier and easier for more and more people to use. So computer literacy is going to be less of a factor as computers become more straightforward and a simpler mechanism to use.

Mitch Kapor: I believe that those people who are comfortable in the operation of computers are going to enjoy certain advantages over those who are not. That is, in part, a class-related distinction. What I think is unfortunate is that it [wouldn't be] necessary in a slightly better world. The issue of computer literacy would be much less of an issue because computers would be substantially easier to use.

Charles Simonyi: Whether or not it is easy to become computer-literate, I think it is totally within the means of practically everyone. It is certainly that much less expensive than a set of encyclopedias, but more importantly I think people recognize its importance.

Gordon Campbell: Well, I think you're going to see two things happening again. I think there will be a continued push for higher and more competent levels of computer literacy. The other side of the coin is that I don't believe it's going to be that major a problem in our society because I think we will compensate by having all these extra MIPS. And the extra MIPS will provide more friendly user interfaces—less efficient ones, but more user-friendly ones. Even people that aren't computer-literate will be able to use [them].

Ken Sakamura: This is why intelligent objects will become so important. Rather than make society more stratified, I think future computers will be power equalizers. An intelligent object is something that anybody can use; it doesn't take the kind of special training or education that PCs today require.

John Caulfield: It's very interesting, and my judgment is that computer literacy will increase. And I'm looking forward to the end of the century to a lot more human-oriented interaction. We're beginning to see this in artificial reality. It sounds hokey and like it could only have arisen in California. But, having said that, it's also real and useful. And I think less computer literacy will be needed. The trend of the Mac will continue, and so "computer literacy" as we mean it now, in my judgment, will be irrelevant 10 years from now. Everybody will be able to use them.

Jerry Pournelle: I think if you can't use a computer 50 years from now, you will be in almost exactly the same position as a person who cannot read or write now. The difference is that I think using the computer will be easier 50 years from now than it is to learn to read and write.

Alvy Ray Smith: To me, it's just like, in order to be a person within our society, you're going to have to learn how to use the tools.

Grace Hopper: I think there will be some people who don't need computers at all. The others will make use of them.

Ryoichi Mori: The more computer literacy distributes into society, the less it will be valuable.

Gordon Campbell: I think when we have all these MIPS to burn and people will have the option just to talk to their computer, that will change a lot of things.

Donald Knuth: There is no universal way—there's not an easy, one-dimensional scale that's saying somebody is computer-literate or not, or anything like that. I see the need for a lot of different flavors of software for different people with different approaches.

continued

ILLUSTRATION: CATHARINE BENNETT


Ryoichi Mori is professor at the Institute of Information Sciences and Electronics, *University of Tsukuba*, in Japan. His primary interest lies in digital systems for the free distribution of electronic information, a concept known as superdistribution.



Nicholas Negroponte is professor of media technology and cofounder and director of the Media Laboratory at *MIT*. He oversees the Media Lab's research into new ways for people to interact with technology.


Theodor H. Nelson is the founder of the *Xanadu Project* and the developer of the hypertext concept. A subsidiary of Autodesk, Inc., Xanadu Operating Co. will ship the Xanadu server next year.

Jay Miner: More and more computers are being designed by computers, and the ability of the average person being able to afford a computer, let alone understand it and learn how to use it, is a very big problem. And the only people that will be getting good jobs will be those that can use computers. And it's a real problem, very big problem. It's stratification.

John Kemeny: I think it will be stratified, but I think it will not be those who have access and those who don't. I think it is more likely to be those who really understand how to use computers than those who don't. I mean, it is closely related to what you are saying, but it is slightly different.

Paul Carroll: I'm hoping that will become a non-issue. Nick Donofrio, who runs IBM's workstation operation, recently said that he thinks the current generation is as computer-literate as any generation from here on will have to be. I think he might be right. People are starting to get the idea that you really do need to make computers far, far easier to use.

Seymour Papert: We must make computation democratic, or there will be an elitist atmosphere and more haves and have-nots. It would be disastrous. I think there is a worldwide movement against elitism.

Federico Faggin: I think that it is going to be similar to what has happened in the past. People [who] have access to education versus people who do not causes the same "stratification." I don't know if I like that word. But, people [with] an appropriate education are able to live in society and function in society naturally better than the people who don't have one.

Dick Shaffer: I think computer literacy is a non-issue. We are moving toward the point where understanding how computers work will be regarded as about as essential to life as understanding how cars work.

Robert Noyce: I think with the increasing capabilities of microcomputers, we will be able to use them [more easily], and more and more people will be able to use and have access to them.

Rich Malloy: I think the process of using a computer will simplify itself to such an extent that it won't be much of a factor. Right now, you do have to know something about a computer to use it. But it could be the case that knowledge of how to use the computer will be as important 10 years from now as knowledge of using a slide rule is today. It's just basically OK, interesting, but not really crucial. I think as interfaces get better, computer literacy will pretty much disappear as a topic.

Nicholas Negroponte: Let's take 10 years as a number. There will be no such thing as a person who can't use a computer. It's not computer literacy that we should be working on, but sort of human-literacy. Computers have to become human-literate.

John Markoff: I basically argue that machines are going to become human-literate faster than humans will become computer-literate. That just seems to be the dynamic, which I actually think is a very unfortunate trend, but it's almost done by necessity. America is not a very literate society. You look at the obvious things, like how many people know how to program their VCRs, and you realize that only 10 percent of the people can program their VCR. The battle's over. A small fraction of society will stay very computer-literate, and [for] the rest of society, they'll develop machines that are as easy to use as televisions.

Jerry Pournelle: It's a leveler. It levels to some extent by intelligence, but it's the same as learning to read and write 2000 years ago. In Jesus' time, those who could read and write were [in] a different caste from those who could not. Nowadays, the high priesthood has sort of tried to take over the computing business. But small computers have a way of leveling things like that. These are great levelers.

Paul Carroll: I'm at least hoping, maybe naively, that from here on, people less and less will have to think of a computer as a computer and will be able to think of it more as something that I do my typing on or something that I do my analysis on or something that I do my homework on. They will get away from this idea that there's somehow a mystique attached to computers and we all need to know what the clock speed of our CPU is.

Dick Pick: It's not so much the computer knowledge as the fact of digital aptitude, and digital aptitude is related to smartness. It's not an equal world. And people who are cleverer and smarter always have a better opportunity to get by in the business world.

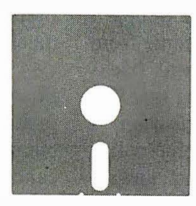
Jack Kilby: Just as literacy has had an effect on stratifying society, I think micro-

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computer literacy will have a similar effect—but possibly less. In the workplace, an increasing fraction of jobs will require more computer skills.

Brit Hume: Well, I'm not sure it will stratify; it's hard to tell, because the people I know who are computer-literate come from all kinds of different educational backgrounds. It's not the kind of thing that you associate with the word *stratification*. I know people who are basically blue-collar workers and electronics enthusiasts, and repairmen who are hunt-and-peck typists, and I've been in their basements and seen their systems. I find it the most democratic and accessible of technologies, and it's accessible to all kinds of people because it isn't very expensive.

Jim Blinn: Computers now are cheaper than stereo sets to a large extent. A cheap computer, to the level of being able to understand what you expect out of [computers], you can get for a couple hundred bucks.

David Evans: It seems to me that there'll be wide ranges of literacy, as there are with other things.

Dick Pick: Actually, I think it will be less than it's been in the past. I think that everybody is scared about technology as being evil, but once the data is out there, once the technology comes to this, I think it is going to have a tremendous impact on making the society freer. I think [that] in general, society is going to benefit from it substantially.

Jonathan Titus: Well, my read is that it doesn't matter, because I'm not necessarily telephone-literate, yet [I can] carry on a pretty decent conversation, and I'm not fax-literate, but I can send something almost across the world to somebody else's fax machine. I think that the computer applications will have to take into account the fact that unsophisticated people will use them, and be so easy and so intuitive to use that you don't have to worry about computer literacy. People don't care about how things are stored, or where they go, or what the connectors look like. They simply want it to hook up and do what it's supposed to do as quickly and easily as possible.

Andy Bechtolsheim: I read a survey that there are 6½ million people in the U.S. who have an M.S. or engineering or medical kind of degree—professionals—that should be using some reasonably advanced computers in their work. I would think that, whatever job they do, what [people] will find out is that they're just that much more effective with the best computer support and tools.

Jim Blinn: I don't know if it's computer literacy that's going to stratify [society] so much as it is just economics.

Stewart Alsop: Computers are like automobiles. I don't mean in a technical sense, but in the sense that they have some significance to society in general. I guess you could make the argument that automobiles have stratified society, but fundamentally we all have access to the value that cars provide. I think computers are very similar in that respect.

Ken Olsen: What comes under the title of computer literacy usually is more harmful than good. Playing games doesn't make you literate. If you really were computer-literate, you would know that transportable software comes from having a language [that] is disciplined. The computer-illiterate person is one who thinks that to have transportable software, you get it from a pegboard, bubble-wrapped, in a computer store, and you play it in any PC. That's naive. Playing a video game in a drug store is not computer literacy. It's fun.

BYTE: ***Computer literacy seems to be a topic that splits you just about down the middle. How about its effect on education?***

David Evans: I think we're going to learn a lot more about how to use computers as tools for teaching. I think we have a long way to go there. If you've tried to look up something in the *Encyclopaedia Britannica* lately, you can appreciate that maybe there is a better way of doing it.

Bill Joy: I'm not sure you can improve education by giving people computers. I think you need to improve education by doing other things. Give people pencils and paper and good teachers, and [a positive] attitude around education. Computers are, like, fifth on my list to address that problem.

Wayne Ratliff: Well, kids are a lot more adaptable than adults. Adults are the ones that worry about it. And I think it is going to happen naturally with kids. It will happen in schools. There will be some, well, stratification, because not every family can afford a computer, although they are going to get cheaper and cheaper. Maybe at some point, maybe in 10 years, they'll be at the point where it will be just like a car—you can't live without it. Maybe if we get to a paperless society of some sort, then you just can't live without a computer, just the way you can't live without a car in California.

Dick Pick: Well, I don't think they're coming anywhere close to being used as they are going to be in education. I think they can change education overnight if there was good software that supported that function. I think to do it right is still pretty complicated. But I think that what's going to have a major impact is when they really start using computers in conjunction with human beings and education directly.

Ryoichi Mori: The consequences will vary widely. For young people who seek a good job, it can be a life-or-death experience. Quite significant portions of education will be spent to give better computer literacy.

Gordon Bell: You see, the problem I have with the computer [is,] I know what the impact could be. What bothers me is, I see the potential. I see what we actually realize, and it's 1/100 of its potential, in terms of being able to be, say, a universal instructor. I mean, what we have there fundamentally is something that can let any kid go off and do experiments in their own home. And that, to me, is the universal science lab. That's what we ought to be shooting for.

Federico Faggin: I think it is very important to put a lot of emphasis on education. Not just because of the computer, but because we have already seen what happens if education is not a priority in society.

Gordon Bell: There's potential with the computer to do some fairly outstanding things by being able to use a machine in the educational process. But so far, the educators, I think, have really shunned the machine. To me, that's a "socio" problem more than a computer [problem]. It may be an economics problem, too. I haven't really looked at it. We ought to be able to lift the whole educational system up very rapidly if we sort of say everybody has to be able to understand at this level.

Dick Pick: The only way you can really get people to build educational systems is if you entrepreneurialize the education system, and that means getting rid of the way it works now, and putting it into a business environment. Then it would happen. I don't see that happening in the near future. It will happen. It will happen out in the universities, but it's not going to happen as

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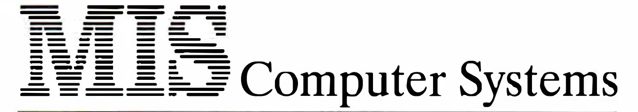
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quickly as it could happen if it was a way to make money. People are in business to make money. That's the way it is.

BYTE: ***And what about computer literacy in society as a whole? Will it have an effect there?***

Jonathan Sachs: It's kind of a fault of capitalism as a whole that it doesn't go after the very lowest groups and try to provide services of any kind to them because they can't afford them. I don't think it's going to be so much of an obstacle that divides people—more of a reflection of the way society is.

John Warnock: I think that that will definitely be the goal, that less-affluent people will be able to get them. The costs would come down, and the performance would be there at the low end of the market, where if they didn't get them by purchasing them directly, they would get them like they get cable TV. But, on the other hand, I know that there are very few people who can run a VCR. There are very few people who can run even the cable box that's on top of their television in any kind of a complete, functional way. The challenge of computers is to get [them] to where they are much more natural and easy to use.

Bob Frankston: We go back to a societal understanding of what computation is. Those on the wrong side are going to suffer. And it's not so much economics as trying to explain what education enables you to do in society. If you're uneducated, you don't even know how to fill out a welfare form. I'm not saying if you're educated you don't need to, but there's a lot of societal mechanisms to help out, and to the extent you understand how to use them and you have skills that are valued, you have an advantage.

Danny Hillis: I hope we're going to reach a point with computing where anyone who is literate will be computer-literate. And because I think fundamentally a computer is no more difficult to interact with than a book, in one sense I think computer literacy will become much broader. On the other hand, I think we have a real problem with literacy [as a whole]. And I think that there is a danger that we are heading toward a two-class society—computers are just a piece of it—that of the people who feel in control of their destiny, and people who feel not in control of their destiny.

Stephen Wolfram: I think it's up to the people in the industry to make sure that there isn't such a segment. It's like asking what's going to happen to the segment of society that can't understand how to use more sophisticated telephones or whatever. The answer is, you try to build telephones where people can use them. Really, it should be the case that absolutely everybody should be able to use a computer. Now, I think there will be a bunch of different levels of computer usage.

Niklaus Wirth: On the one hand, [we] hear about unemployment, and on the other hand, we continuously experience that we do not get people for doing the work which should get done. And if you look at it closely, you have unemployment among the untrained and you have great demand for people in areas where some qualifications, particularly high qualifications, are re-

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quested. I think that the computer, unfortunately, helps in widening the gap between these two categories and even among the people in the profession. That gap will widen between very competent ones who have mastered their subject and those who just do it as a job from eight to five.

Jonathan Titus: We still have a ways to go to convince the average person that there's a real, practical use for computers day to day, week to week, and month to month. Just as the telephone is almost indispensable these days, I think that in the next, let's say, seven to 10 years, the home computer, or some form of computing device in the home, will be almost indispensable.

Jim Blinn: It's just one of those things that you need to know how to do.

Bob Frankston: Computers force you to rethink. Once you learn a foreign language, you understand English better. Well, computer literacy is the foreign language of society. It makes you understand the other things you're doing better. And that's what I view as the core to computer literacy and where the value comes toward dealing with society.

Tom McWilliams: Actually, I think that in the nineties, we're seeing a great deal of increasing computing power per dollar. I think an awful lot of that computing power will go to make the user interface better. I think that in the nineties you'll see more voice input and more visual integration: imaging on the screen, so that you can mix things like live video on the screen with text and voice—if you can imagine, a very nice mail system where you could literally talk, type, or have a video in your mail. A lot of things I think will greatly ease the ability to use computers so that basically the computers will come more to the masses rather than the masses having to come to the computers.

BYTE: ***What kinds of questions, then, does computer literacy raise for the future?***

Nicholas Negroponte: Will computers make your life better and your day more pleasant and so forth? My answer is, unequivocally, yes. In the old days, the very wealthy had servants, a maid and so on, who did things for them. Having a gardener or chauffeur didn't mean that you couldn't enjoy planting a garden or driving. But you did have at your disposition a retinue of servants who were there to make your life much easier. If one thinks of that as a model for computers—there are these agents that do things for you, [like] don't let the telephone ring in the middle of dinner, and are so interconnected [that your computer] knows your flight to Detroit is delayed 2 hours, so it tells your alarm clock you can sleep a little later.

Terry Winograd: Is the question one of technological determinism, or is it a piece in a puzzle? There are some people on each side: Some people who say it stratifies, and some people who say it empowers. What is the goal? To have a computer in every home? If so, computers will go one way. If it is for schools, computers will go another way. It is a mixed bag. Neither the utopian nor big-brother fantasy [will] play out uniformly. ■

Dennis Ritchie:

On Plan 9

In terms of the operating-system-related stuff, [we're working on] a new system called Plan 9. It's not Unix, although the interface is rather similar. It's not an attempt to re-create Unix as such. It's an attempt at a fresh go.

All the code is new. It's fairly highly distributed, and it's intended to be quite growable. A single configuration can grow gracefully into quite large ones by adding CPU servers and file servers and so forth. The computation tends to be split between both the terminal and CPU servers, [which] run a very similar version of the same operating system, and sort of talk to each other over some kind of a network.

The intent is to be able to produce systems that have a reasonable amount of CPU power nearby (within the display), that connect seamlessly to much larger sets of resources that are more remote (in particular, in rooms that can be air-conditioned and serviced by technicians instead of the user), and have this all done fairly smoothly so that you can't really tell by looking at it where something's being done. And second, [do this] in a way that doesn't have all of the barnacles and so forth that have grown up over Unix over the years.

The system itself is very much a research effort at this point. There's no thought certainly in the immediate future, or perhaps even the longer-term future, of having this [become a] product. It's very much experimental. In fact, it's not even the dominant platform for our own computation in the research group. It has some users, but [we're still] knocking off the rough edges and whatnot, so it's not universal. The terminal hardware that it runs on is very much like a diskless workstation. It has extensive memory and a CPU and memory map and a network connection and a bit-mapped display, but the way in which it interacts with the rest of the world is more tightly coupled with the other resources.

The main problem at the moment—the main conceptual problem—is that it looks like the communications bandwidth it wants is a bit too large to be conveniently taken home. It works fine in the office. One of the things that we like very much about our current world is that the same facilities are available both in the office and at home. Moderate-speed phone lines are adequate for that.

[Plan 9] looks as if it's pushing the edge as far as the speed is concerned, even though we're very hopeful that the phone company, speaking generally, can provide some sort of more adequate bandwidth. ISDN is the next hope. On the other hand, because this thing is new enough, the amount of engineering and squeezing has not been done that might be useful. It works fine at T1 rates, a megabit per second, and that's very much achievable in local context. It's also achievable at home, but it's expensive. It's not as if you needed to be on an Ethernet. A tenth or a twentieth the speed of the Ethernet is sufficient. But that's still a bit rich for really far away, where you actually have to rent stuff from the phone company. And things like ISDN, those experiments should be coming fairly soon.

[Plan 9] starts out afresh, makes some fresh assumptions about interfaces and design.

Editor's note:
See biography, page 336.

Nicholas Negroponte:

On Future TV

There are a lot of things about the future of television, but one of the things we can say, unequivocally, is that it will be digital. And once it's digital, you can start doing a great deal more than our current sort of analog, rather outdated systems. I think that the merger, or combination of television technology and computer technology, is going to happen within the next decade.

Quite curiously, you have TV manufacturers right now who are putting more and more computing into the TV set, and you have every computer manufacturer you can name putting more and more video into their computers. And these groups are really not talking to each other yet.

I think what will happen is that people who are putting computing into TV sets—I think they'll fail, because I don't think the market is going to help them very much. What's going to happen is that computing people who have started putting more and more video into their computers will find, 10 years from now, that they are the de facto TV set.

Editor's note:
See biography, page 304.

Ed Yourdon:

On the Future of Software Development

We are building very different kinds of systems than we built in the 1970s. For one thing, there's obviously much more emphasis now on the user interface.

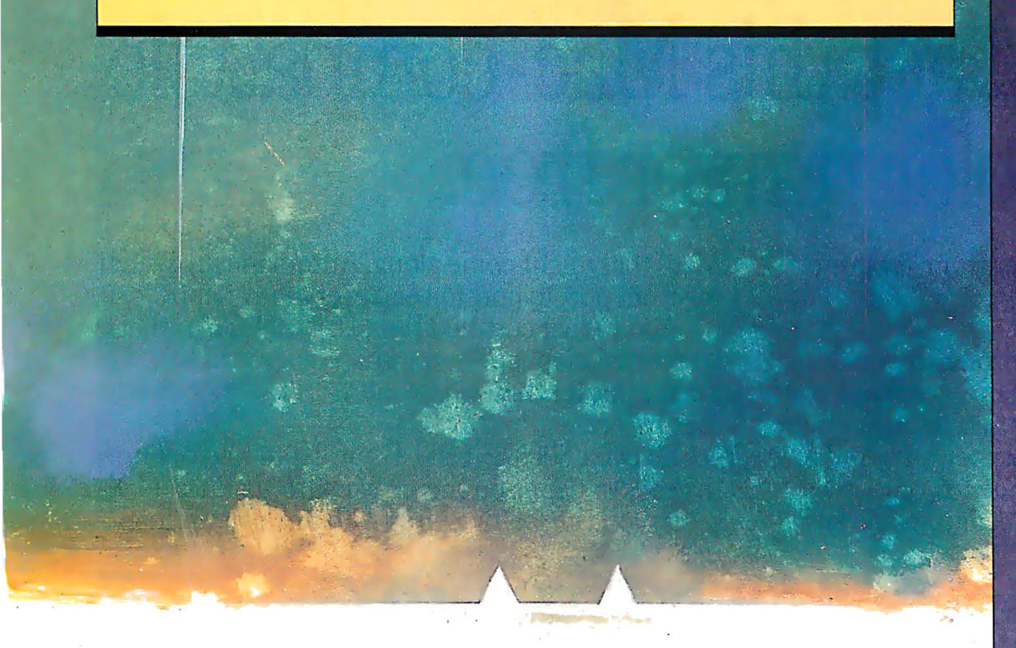
I've heard Bill Joy of Sun Microsystems say that a typical software system today (you know, a windows, graphic-user-interface kind of world) has 75 percent of the code tied up in the user interface, and only 25 percent doing number crunching. You know, most of the earlier methodologies provided no assistance—no guidance at all—for the user interface side of things, and it is such an obvious candidate for object-oriented design.

Also, [earlier methodologies] provided almost no emphasis on reusability, which many of us are now beginning to think will be one of the big solutions to the productivity problem. [Earlier methodologies] had a little bit of notation for showing a library module in the structured-design approach. But this whole object-oriented concept of inheritance and subclasses and so on really, I think, causes a profound difference in the way that people approach problems.

If you watch your typical programmer or software engineer who's grown up using, say, my methodology or any of the other comparable ones, you'll see that the way they approach a problem is by taking out a clean sheet of paper or a blank CASE tool and trying to invent a system from first principles, as if it had never been done before, because that's how they have been taught. Whereas, if you watch a Smalltalk programmer, given a new problem, he will immediately say to himself, "This must be a specialization or a slight variation on something that already exists. Let me browse through my library and invent some new subclass that inherits a whole bunch of stuff from existing class structures."

So the person who works with a good, strong, object-oriented set of tools inevitably will look at a problem as a design by exception or design by refinement process, which is a whole different way of looking at problems. So I think that [object orientation is] terribly, terribly important.

Editor's note:
See biography, page 366.



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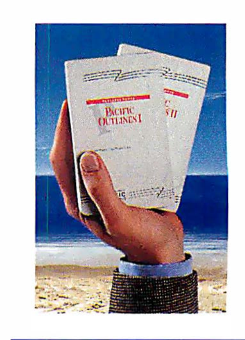
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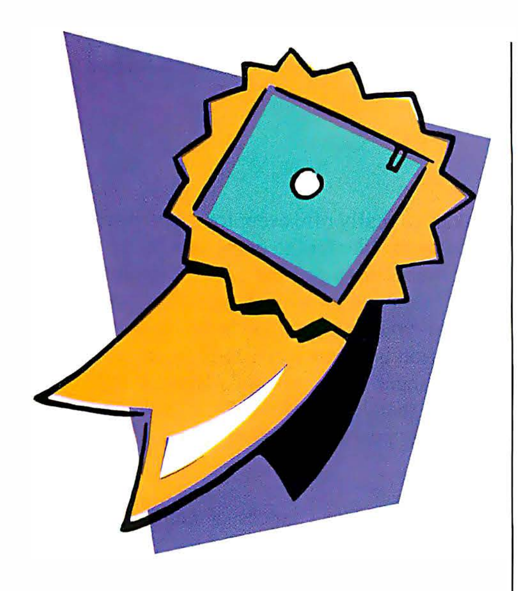
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n application isn't any less life-changing if it only changes a few people's lives. It still changes them as profoundly.

—Jonathan Sachs

What do you think will be the next "big one," the next huge success, in the software world?

Charles Simonyi: I don't know. What will it do for you? If it doesn't do something that the people are doing right now in great frequency, it couldn't possibly be that important.

Brit Hume: I must say that I do kind of root for some of these interesting new programs that they're developing to run under Windows and OS/2. There's a lot to be said for that kind of interface. It is easier to learn and use. But so far it's hard to see that there's going to be a massive migration any time soon to that sort of thing.

Bob Frankston: The next step is that my windowing system will have animation as a fundamental capability. We know what we want to do, we know how to do it—we're just waiting for the prices to come in line. The challenge is always to do things a little more before most people realize they're economically feasible.

Bill Stallings: Animation. That's something that takes advantage of the capacities available, and the advances are being made in image processing and video processing. And applications that'll involve [animation] can be things like training. It's kind of the next generation of presentation software—systems that would make it easy to put together animation. I think that that could have a really big impact in business.

Jerry Pournelle: It'll be integrated multimedia stuff—make use of glass disks and visual images and music and sound.

Tom McWilliams: If I had to speculate off-the-cuff, I would say the integration of live video and voice into some sort of tools to help you do your office work. There are a lot of companies that still have a tremendous paper mill, which is very inefficient. So I think that the computing horsepower is going to be there—and the network bandwidth—to help you really automate the office. We ought to get rid of interoffice mail. I think you can do it much better. The enhancements of video and voice on top of written text is a very powerful communication mechanism.

Doug Engelbart: Multimedia hypertext. I think it's going to be *the* way in which the electronic document, so to speak, is going to emerge, and it's going to be hyperdocuments. That's going to put a tremendous amount of pressure on standards for intercommunicating for the document that won't have it—a much more challenging era of standardization than I know of that we've done before, because of the diversity of the forms of what we call a document.

Bill Gates: Group productivity, advanced mail stuff—a lot of opportunity there. And everybody recognizes that. The idea of dealing with heterogeneous information, the type of stuff you get in personal information management—I still don't think anybody's done a very good job there. Particularly as we get these notebook machines with handwriting and the graphics interface, there are some real opportunities to advance that.

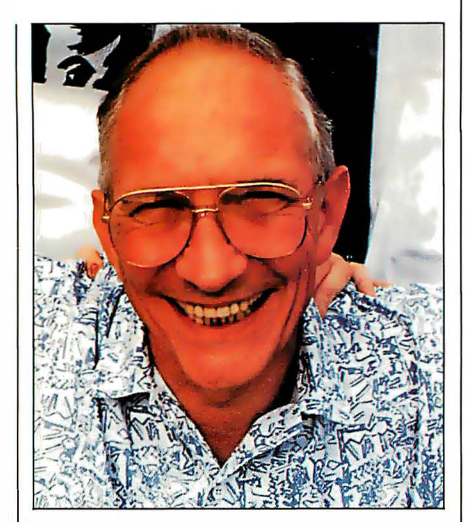
Dick Pick: Certainly, there is sort of a revolution going on now in the general area of visualization CAD/CAM. That's what's driving all those workstations out there, I would imagine. I would say that's the one that's kind of hot now.

Doug Engelbart: I think [it's] the evolution of portrayals and symbologies that we haven't really harnessed very effectively through all the decades and so haven't been a part of our general way of externalizing our thoughts and our communications. That's the part of the augmentation area that I think is just really, really [exciting]. It's like the means by which we can actually transfer from our head into some kind of external model of what our concepts [are] and the communication we're trying to do and attitudes and feelings and the portrayal back to us, whether it's by sound, smell, anything else (vision, three-dimensional, dynamics, others)—sensory immersion and virtual realities and all of that.

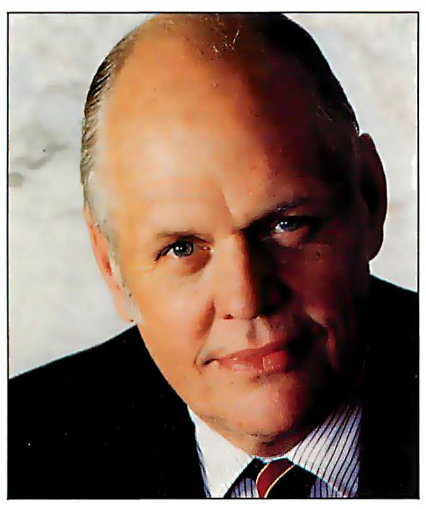
John Markoff: I don't think I could name the exact application, but I think it's going to have to be in the communications area.

continued

ILLUSTRATION: CATHARINE BENNETT



The late **Robert N. Noyce** was president and CEO of *Sematech*, and vice chairman of *Intel*, which he cofounded. He and Jack Kilby are credited as independent coinventors of the integrated circuit. Along with Kilby, Noyce was the recipient of the first Charles Stark Draper prize from the National Academy of Engineering.



Kenneth H. Olsen is founder and president of *Digital Equipment Corp.*, the nation's second largest computer maker. He precipitated the movement toward smaller, interactive computers with the PDP-1, the first minicomputer, and has led DEC to a leadership position in networked computers and systems integration.

It's going to have to be something that can make communications extremely transparent. And whatever the software is, it's got to be an order of magnitude more convenient than terminal-emulation programs or communications programs today.

Bill Gates: In this client/server thing, the idea of seeing corporate data graphically, being able to browse around it very easily, and have it sort of remember what stuff you like to see and make it easy to call up. That whole way of seeing your corporate data—nobody's really done very well with that. That's a big area. Some people call it database front end, but that's just because they're using the old label on a new thing.

Grace Hopper: Ever since the early days of COBOL, something has disappointed me. I thought that when we designed COBOL, if you remember, we designed the ability to use the library—the subroutine. And I thought the Insurance Association would immediately get together and write all the subroutines necessary for insurance companies to meet government needs. It's never been done. Then banks never wrote that subroutine that would provide for all the reports. And those libraries don't exist. That libraries ability in COBOL has never been used the way it should have been. It should have been one subroutine.

BYTE: ***Do you think there will be any other "killer" applications, like word processing and spreadsheets, that dramatically increase microcomputer usage?***

Grace Hopper: Oh, yes. We haven't yet thought up all the things we can do with this technology, and how to match them together.

Jim Blinn: We seem to be entering in the world of generic things, generic entertainment, generic music, and generic software. The one thing about the PC area—it's not necessarily IBM PC-type things, but other sorts of machines, Macintosh and whatever—is the fact that you can get lots of different software from lots of different places that can work together and can talk to each other, and the output of one can be used as the input of the other. This is a fairly remarkable thing from the computer end.

Jonathan Sachs: I think there is a limited number of generic product categories. A spreadsheet is a really nice generic tool. A word processor is probably the ultimate generic tool, because almost everybody writes at some point in their life. But I think it's a really rare event for a new product category like that to come into being. I think we've seen the big generic applications. I think we've seen the specific applications—you know, the sky's the limit. An application isn't any less life-changing if it only changes a few people's lives. It still changes them as profoundly. I guess the answer is yes, but not for everybody at once.

Tom Kurtz: The chances of coming up with a product that will somehow take off the way the spreadsheet took off are really small.

Dick Shaffer: I think stylus-based systems have the potential for important applications. But you have to build a whole new class of machines before you can even get to that level of applications. I'm talking about the computer that takes the place of your notebook, takes the place of your diary, your calendar, your phone book. It is no heavier than the paper book you carry around, and it is more useful than that. It is your basic digital life organizer. I can see that as reasonable. At least three [companies] in the U.S. [are in this field], and in Japan, every major vendor of computer systems has a project in that area.

Wayne Ratliff: But any breakthroughs you can't predict. Is there room for breakthroughs? I suppose so. I mean, if someone could make speech recognition reliable—really working—that would do it. I think speech recognition is going to be what turns the corner on computers. As soon as they get as good as the HAL 9000, that number is going to squish to about 90 percent. It's going to do a flip-flop. It's going to become the inverse, the complement of what it used to be, in very, very short order.

Rich Malloy: I don't know. I would say a product that would be a little different than what we're using now. A lot of products on computers allow us to do more work, but they also require more on our part. And what would be interesting is some kind of software that would allow us to do a lot of work with very, very little work on our part, sort of a work amplifier.

Brian Kernighan: We have made progress in getting programs that are better, that run better, that have fewer errors, and so on, when we've been able to get machines to write them for us. Now, I don't see automatic programming, where you simply say to the machine, "OK, I need a program to

continued

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See Page 145.

DRI To Upstage Giants With Own DOS 5.0

By Gina Smith

Users hungry for the memory relief promised by DOS 5.0 will be able to buy the system software next month—but not from IBM or Microsoft Corp.

Digital Research Inc. (DRI) is poised to release DR-DOS 5.0, the latest version of its DOS-compatible operating system. Early users and company officials say it offers many of the key features planned for Microsoft's unannounced DOS 5.0.

DR-DOS 5.0 is the first commercial version of the previously OEM product. Its most noteworthy feature is a memory-management capability that allows users to free as much as 620K bytes of memory for application use, said Dick Williams, president of DRI in Monterey, Calif.

Although Microsoft officials have said that a new DOS version with similar features will be shipped by year's end, sources say that version is in the very early stages of development.

"Microsoft is only promising this, and DRI will be shipping soon. If [DR-DOS] can prove it's really compatible, and if it looks good, I'd have no problem recommending it," said Bob Hollingsworth, a computing consultant for an automobile maker in Detroit.

"I don't care whose name is on the package if it can help us with our memory problem," said Darrin McCarthy, end-user computing analyst with Porsche Cars North America Inc. in Reno, Nev.

Beta testers report that DR-DOS 5.0 includes a number of features not found in current MS-DOS and PC-DOS versions. Among them are a graphical,

See DRI Page 6

FIRST LOOK

Turbo C++ Delivers Power To Programmers

By Peter Coffee

D-14 Sunday, May 20, 1990 ★★ SPECTRA

JOHN C. DVORAK

ASK DVORAK

graphical user interface designed to be used equally well with a keyboard or a mouse. ViewMAX allows for easy execution of DOS commands and "point and shoot" running of any application software, eliminating the need for users to learn and correctly execute cryptic DOS commands. The user's disk layout can be viewed as icons, text or in a graphical tree format.

Users who need to transfer data from one machine to the other can do so easily with FileLINK, a file transfer utility included in DR-DOS 5.0. FileLINK provides easy, high-speed transfer of files and programs between systems over standard serial cables. The utility installs itself from one machine to the other via the serial link, so DR-DOS 5.0-based systems can communicate with machines running less functional DOS operating systems.

A major advance in DR-DOS

San Francisco Examiner

BUSINESS

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The Press goes on to mention that because DR DOS 5.0 is fully DOS compatible, you can run all your current DOS applications. And because it is easy to install and requires no hard disk reformatting, upgrading to DR DOS is simple. Since DR DOS 5.0 also includes ViewMAX™, a graphical interface, DOS is easier than ever to use.

Now if we could just get a word in edgewise, we would simply like to add that DR DOS 5.0 is available now. Call us at (800) 848-1498 Dept. DR-44 today.

DR DOS 5.0



For Laptop and Notebook manufacturers, DR DOS 5.0 is fully executable from either RAM or ROM. And, it's available with BatteryMAX™, a battery-saving feature that can increase battery life 2-3 times (dependent upon OEM implementation).

do this," and lo and behold, out it comes. But I think what we will see more of is places where people understand some corner of activity well enough that they can go from a specification of a solution to a working program to do it fairly quickly. I don't think we're ever going to get to the point where the machine will write all our programs for us, but we can do better than we're doing now.

Jim Blinn: The one main software innovation that I've been most impressed with in the past 10 years, I think, is object-oriented programming—the fact that it enhances the stability, it could take little bits and pieces of a program—device drivers, interrupt stealers, this type of thing—written at different times by different people, and have them still be able to be plugged together, if it's done carefully.



e haven't yet thought up all the things we can do with this technology.

—Grace Hopper

Paul Carroll: I don't think that there will be a next killer application, in the sense that spreadsheets, word processors, and databases were. There are some very powerful things that will become available. Multimedia is important, electronic mail is extremely important, handwriting recognition, and then maybe a decade after that, voice recognition will be important things. Groupware is also very important. It does not seem to me that any one of those things will be an isolated app in the way a spreadsheet is. I think electronic mail will become a part of everything. I think groupware is a concept that will be folded into things. I think multimedia is a technology that will find its way into different things.

Brit Hume: I think that it's interesting that we've had to wait so long for a major new application, and there hasn't been one in a very long time. And you see the efforts that people have made to develop something truly new, and what tends to happen is, we have glorified utilities being passed off as new applications. But when you get right down to it, it's not really an application, it's a housekeeping program. And I think the same can be said for some of the communications software that has been loaded up with all kinds of wondrous bells and whistles. But when you get right down to it, a communications program in a sense is really a utility. It is not something you use to create work. It is simply something you use to move something from one place to another. Important, indeed indispensable, but it is not like a spreadsheet, a database, or a word processing program, something that can itself be the substance of your work. And we haven't seen anything in some time that would be a brand-new way to use a computer to create work. The last really new application we had was desktop publishing. ■

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Bill Joy:

On the Longevity of Unix

I am always reevaluating what we should do to keep Unix evolving. The system is the only operating system that has been around for a long time—it's like 20 years old—that runs on micros.

The Mac system is maybe eight to 10 years old. OS/2 is a year old. And DOS, maybe 10 years old. So, [Unix] is the only one that has survived 20 years, and it has survived because it reinvents itself. It goes through cultural renewal.

I think we have a very healthy culture of constantly figuring out what to change to keep the system relevant. I try to be a rabble-rouser, I guess, to encourage people to continue to change the system. So, we've got a big intellectual investment in this sort of moving cloud of capability that the system has. I spend a lot of time doing that. That's sort of a social project as well as a technical one.

Editor's note:
See biography, page 262.

Grace Hopper:

On the Value of Data

Since 1943, when the first computers appeared, we've gone after hardware. We've gone after faster hardware. Everyone is worried about hardware. Along about '51, '52, John Mauchley came out with that first short code, and then came FORTRAN, then came COBOL, and we started the software world, and we developed the languages, and the user-friendly stuff, and everything. Nobody has yet looked at the data.

There are clearly two kinds of applications—two major classes of applications. The big scientific/engineering research, which is largely mathematical in nature, [and] then there is the large data-processing world, which is largely arithmetic in nature. So, we never really designed computers for either world, because we wound up building von Neumann computers. And until we look at the data, we will not come up with a new articulation.

I've been thinking about data flow and the different kinds of data flow. Now, sometimes data flows like rivers, sometimes it flows like that lava out in Hawaii, sometimes it's like a marching company of marines: organized, disciplined. [And] sometimes it's more like the flow over the wing of an airplane, which gives the lift and has the turbulence to fly, too. We've never looked at the data, how it arises and how it flows.

I think as we build these systems to compute, we'll become more aware of the data flow and more aware of types of data. For instance, the scientific/engineering field doesn't give a hoot about an alphabetic character. It is largely binary and floating. In data processing, it's integers and add, subtract, multiply, and divide: only arithmetic and comparisons of those alpha-decimal characters.

We haven't looked at the amount of work being done on data. Long ago, in the earliest computers, we discovered that you could always go faster if you had more space, more storage. We've never looked at the value of the data, the value of an education.

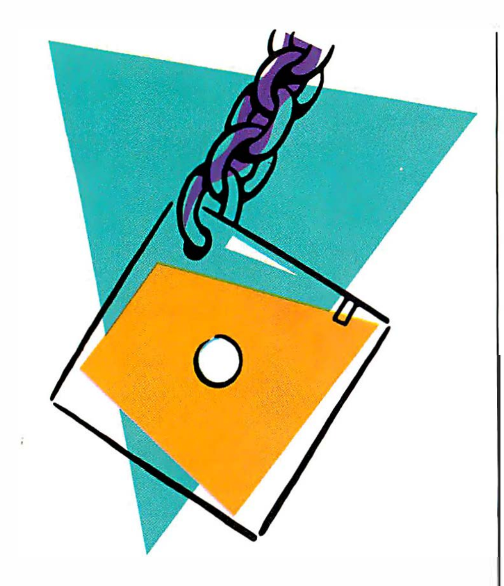
Well, some of the stuff going through the computer is a heck of a lot more valuable to us than the other stuff is. Nobody has even gotten a little bit philosophical about the value of information: All information is good; put it in the computer and run it over the lines.

We need to look at the stuff and what can we afford to lose, what can't we afford to lose. Part of it is leading us toward the future. Part of it's just a relic of the past, and so on. With just a narrow look, we've taken these lovely computers, faster transistors, everything under the sun, better language, more software—pile it in. We never think of what we're doing it on.

I think until organizations begin to look at the information, as long as they look only at the computers and telephone lines that they control, they're not doing their job. They're not looking at the information itself. They're not looking at the value of the information. They're not looking at who uses it and why, the kind of information, what it does, where it comes from. The value is a big thing we've never looked at.

Editor's note:
See biography, page 257.

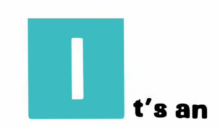




THE BYTE SUMMIT

THE SOFTWARE ANCHOR

Why is software so far behind hardware?



It's an understatement, because hardware is astonishing, and software is primeval.

—Ted Nelson

Bjarne Stroustrup: Why are we lagging so far behind? I'm not so sure we're lagging far behind. I think people are skewing their comparisons.

Niklaus Wirth: Well, first of all, I don't know whether software is so far behind hardware. It depends on what do you mean, "behind." I guess what you mean is that hardware technology has made such vast improvements—they give you 10 times the power for 10 times less money now—whereas software seems to become more and more expensive.

Wayne Ratliff: As soon as computers are made bigger or faster, you can take advantage of them almost immediately. In that case, we keep right in pace with hardware. I guess overall, I don't agree. I think that software is actually outstripping hardware.

John Warnock: The systems are getting extremely large. The management of software and the management of innovation in software [are] extremely difficult. If you're looking at OS/2 and Unix and DOS, these are all 1960s operating systems. They don't have the concepts of really first-rate, advanced-technology operating systems. The industry has to figure out a way of abstracting itself out of the current mess it's in.

Wayne Ratliff: Actually, I kind of came to the opinion that software's exceeding, outstripping hardware fairly rapidly. Hardware is sort of always trying to keep up. We always need these 20-MHz and 33-MHz and 50-MHz machines to try to make software jobs that are already invented practical. I think [that] the biggest point where software isn't really keeping up is not software's fault. I don't know if it is anyone's fault. But it's the fact that users have so much invested, there is so much momentum in DOS. DOS has a 640K limitation, software limitation, ultimately. That is really holding things up.

Alvy Ray Smith: Well, it's very clear that we are going to have to tighten up our software act. I suspect that we'll have to do things like CASE tools and something equally important so that we can work together. My own strong vision of how it's going to turn out is that picturing will become a major part of what you see on the desktop. And by picturing, I mean any use of a computer to make pictures.

Jonathan Titus: I think it's just how we develop software. We tend to develop software the same way we did when I was programming PDP-8 minicomputers with 8K of memory. It's one instruction after the other. We really haven't yet gotten to the point where computer-aided software engineering or CASE-type tools help out very much. What we want to do is draw a grand picture of what we want to have happen, and work that down through our CASE tools.

Michael Slater: But I think there will always be an inherent couple-year lag in the software really taking full advantage, simply because it takes a long time to develop sophisticated software. I don't think there's really any way around that.

Stewart Alsop: That's a natural process. Software has to come after hardware. This is the chicken-and-egg conversation that people always have. Without hardware, software is nothing. Without software, hardware is nothing. But you've got to have the hardware first. You can't write the software until you've got the hardware, so there's always going to be a delay between hardware and software.

Jim Blinn: In the past, somebody comes up with some hardware, and the software people can't do a whole lot until the hardware exists. They can do some simulations and so forth on other computers, but once the hardware comes out, the software people go to town and start doing things. Meanwhile, the hardware people are making something new. Before the software people have a chance to really exercise the existing hardware for all it's worth, that hardware is obsolete, and the new hardware comes along. The thing that is going to change that is some stability in the hardware end, like systems of machines that are software-compatible, VAXes, for example, or PCs or whatnot, so that software development 10 years ago still is relevant to the hardware now. Even though the hardware might be able to do more, at least the stuff you did 10 years ago is still usable.

Tom McWilliams: First off, hardware at the level that the user sees [it], mainly at the instruction set and so forth—architectures—have made advances. But, the machines aren't radically different from what they were years ago. Most of the hardware

ILLUSTRATION: CATHARINE BENNETT

advances have been driven by the underlying manufacturing process technologies: the ability to make faster, smaller transistors and so forth, rather than revolutionary ideas in hardware. The problem is that to change the language people program in requires that you retrain all the people and you rewrite all the software.

Ted Nelson: In one sense, it's an understatement, because hardware is astonishing, and software is primeval. On the other hand, hardware that can only chase its own tail is an empty exercise. The brilliance [with] which hardware has been built is mindboggling. The dunderheadedness with which we have been unable to do decent software is also mindboggling.

Bjarne Stroustrup: Yeah, the hardware we have today is astonishing. I mean a pocket calculator can outperform the first digital computer. On the other hand, the user interface used to be, you took this paper tape and walked up to that monstrosity to feed it, and the output came on a printer or in some cases some dots on a screen that you had to convert back from binaries to something digital. And these days, the user interface to the average user is this point and click and there's pictures coming up and there's network software that allows me to get a message deposited in my friend's mailbox in Lund [Sweden] in about 1 second. I'm not sure software's behind.

Wayne Ratliff: There's certainly a lot of evolution and speed capability and capacity. I think that software, if anything, has gone through pretty giant revolutions. I mean, look at the GUI interface—that's just a dazzling thing that's happened in the last 10 years.

John Markoff: I guess I think it's because it's not an engineering discipline. Software is closer to the act of writing literature than it is to engineering. For that reason, you know, there's good art and bad art, and it has to do with human creativity. I think the reason there are too many different interfaces is, we don't understand how to do it right.

BYTE: ***Do you think software's just more difficult than hardware? Is that part of the reason?***

Dennis Ritchie: I think that inherently it's simply more complicated. It's possible to put more structure into the software. Any physical object has a natural size, beyond which you really can't push it. A microprocessor chip is a very, very complicated object. But, nevertheless, there is a certain size, and you know the size in advance. If it looks as if you can't achieve your objective within that sort of size bound, you simply say at some point, "We just can't do this." It fails. It falls over. It just doesn't happen. Either that or you keep it within the size. With software, there's always a tendency to believe that you can add more, and the complexity can simply grow almost without bound.

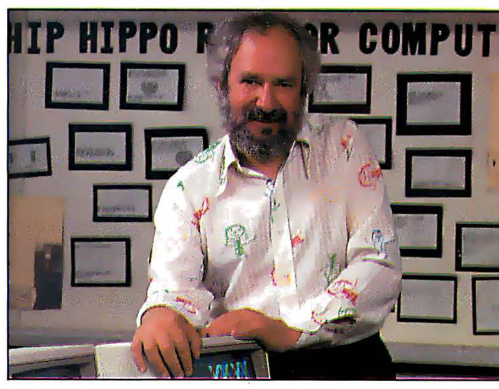
Rich Malloy: I think the problem is basically because the hardware is easier to do. It's much easier to get sidetracked in developing software and to get carried away in various features and to go off on various tangents that take away from the current project, the current goal. Whereas [with] hardware, you're pretty much limited by the size of the chip and by the complexity, and people are planning much more carefully about what the chip should do.

Stephen Wolfram: Software, in a sense, requires a much more sophisticated design than hardware in order to work properly. What your piece of hardware is supposed to do is fairly well understood. The details of the engineering of getting it to [work] quickly and so on and cheaply, that's a hard problem, but it's a fairly well defined problem. In software, things are a little less well defined. You take some general area like mathematical computation or something, and you have to design a system that can be effective in letting people do that kind of computation—that's pretty hard.

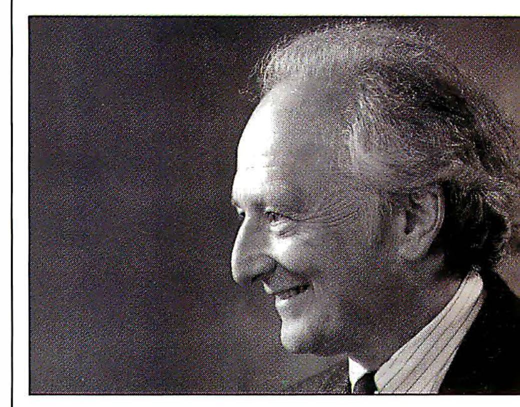
David Evans: I think that we're building more complex systems, more complex software systems, than we are hardware systems, for example. What's late now is the software—the systems stuff. And some infer that we don't understand it as well as we do the hardware, or it's more complex.

Bill Stallings: On the hardware side, as you get into more and more complex applications, what you need is a lot more speed, processing power, and a lot more throughput. And the transmission systems and the processing speeds, the storage capacity is continuing to expand at an extremely rapid rate. It's almost straightforward how you do that. You know that every *x* years you're going to multiply the storage capacity by a factor of 4, as far as things like RAM chips [are concerned]. And those are almost physics problems. But, on the software

continued



Seymour Papert is professor of mathematics and education at *MIT*. He is cofounder of the MIT Artificial Intelligence Laboratory, where his research led to the development of the Logo programming language.



Charles I. Peddle is president of *THStyme*. He designed many of the more important and successful early microprocessors, including the 6800 and the 6502.

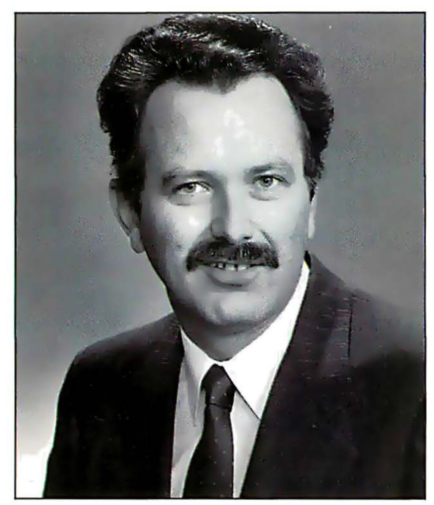


Richard A. Pick is president of *Pick Systems*, which develops and markets the Pick Operating System. He developed the underlying concepts for the Pick system while at TRW during his nearly 30 years in the computer industry.

S. PAPERT PHOTO: KRAMER PHOTOGRAPHY



Jerry Pournelle is a science fiction writer and a regular columnist and senior contributing editor for *BYTE*.



C. Wayne Ratliff is president of *Ratliff Software Production, Inc.* He is the creator of dBASE II and dBASE III, the most successful DBMSes for personal computers. In 1978, he wrote Vulcan, the precursor to dBASE II, on a home-built computer.

side, how do you go from using a mouse to using voice input? That's a qualitative difference, not just a quantitative difference. To keep driving to more and more sophisticated applications, you need quantitative improvements in the hardware and qualitative improvements in the software. And it's a lot tougher to do the latter.

Charles Simonyi: It might be the case that software is inherently harder than hardware, and the usual argument [is,] "How come you know a bridge can be built on time but the software cannot be built on time approximately?" The reason is that a bridge includes a lot of repetitive components, like all the rivets are the same, and in software every time you seem to be doing the same thing, you either create a loop or create a subroutine. In principle, you never do the same thing twice in software. That is why I think it is the hardest thing in the world, because you never repeat anything.

Brian Kernighan: It's too hard to write programs. It's incredibly hard to write programs. We have to tell the damn machine too much about how to do things. We often don't understand it well enough to spell it out in detail. When you spell it out in too much detail, you lose track of what's going on in the details. It just doesn't work. The field is just riddled with examples of things that are too big, not well thought out, don't work right anyway, or are years behind schedule, everywhere.

Dennis Ritchie: I think it's because software simply is able to grow in complexity and in size and without being easily predicted how complex and large it's going to be to do a particular job. And there is no special bound to the extra stuff you're tempted to add.

Donald Knuth: I think that software just has so many more problems to solve than hardware does. If you ask the hardware people to make hardware compilers or spreadsheets or whatever, they wouldn't be any better at it.

Bill Stallings: I think it's because you're no longer dealing with a small, sort of elite trained group of people using the software. You're trying to make functionality available to the people that are doing the work in an organization. And you're getting into issues like ease of use, and even more into issues like artificial intelligence to do that.

Brian Kernighan: I don't know. I suppose you could argue that part of the problem with software is that it's, on the surface, so flexible that people get sucked into flexing it, spending all of their time changing, refining, and we'll just fix it up in the software thing. And you spend more and more of your time changing requirements for programs. Part of it is, perhaps, that it still seems to be an art form that everybody thinks they can do, whereas hardware is not an art form where everybody thinks that they're experts. Well, I guess it's partly natural. I do software, not hardware, so I think the software is necessarily harder. It's more macho to write software.

Alan Kay: The best new software things I've seen in the last couple of years, I've seen in Japan. Software is not any more difficult to do than hardware.

Stewart Alsop: We got into a particular situation where software got way behind hardware, because you can deal with hardware all you want, but you can't create standards without software. So, I'd say that over the next couple of years, by 1993, that we will have finally made our way through that transition. The gap between hardware and software will go back to a natural gap instead of the unnatural gap that we've had, of software being three and four years, five years behind the hardware, instead of just 18 months.

Bill Gates: There's just some reasons it fell behind. It won't be behind. It will be catching up.

Stewart Alsop: The thing people forget is, this never has happened before. We have never had an industry like the personal computer industry. We've never had a product that was a multipurpose technology like personal computers. All other technologies before have been dedicated to a particular purpose. What makes PCs different is they can be configured to deal with lots of different things.

BYTE: ***That does seem to shed some new light on the subject. Perhaps we're expecting too much of software.***

Doug Engelbart: [Software is] a different kind of challenge without the same bounds that the hardware thing has. And then, it's not as visible. To make an analogy, it's as though you were building something physical—you have a limited number of kinds of parts and ways to assemble them, etc. There's still a lot of room for cleverness and design. But in software, you've got a

continued

J. POURNELLE PHOTO: ROBERTA POURNELLE
C. W. RATLIFF PHOTO: BRONSON PHOTOGRAPHY



software is inherently harder

than hardware.

—Charles Simonyi

limitless number of complements you can put together. It certainly needs more discipline and methodology and tools, but it's tough, a much [more] wide-open intellectual problem.

Charles Simonyi: Some of it is psychological, in that software people are very, very cognizant of the efficiency, or rather the lack of efficiency, in their product, whereas they are not very cognizant of the same in the hardware side. When we publish a product, we know how much it could be improved by extra effort. So, in a way, we always feel kind of ashamed that we haven't exploited the absolute maximum that is offered by the hardware. But for all we know, the hardware hasn't exploited its own potential. It is very frustrating how far the ideal in your mind is from the reality in the product.

Niklaus Wirth: The point is, if only hardware would make these advances and software not, then my question would be, why not put everything into hardware? The fact is we have software because the custom tailoring of the machines is so expensive that it is still much cheaper to use software than hardware.

Gordon Campbell: I think the fundamental limit is cost on the hardware side. I think it was Bob Noyce who somewhere gave an example a lot of years ago. He said that if the automotive industry had made the same kind of progress that the semiconductor industry had, that today we'd all be able to go out and buy Rolls Royces that would get more than 1000 miles per gallon and cost less than $100. And somebody else added later that that's probably true, but the fundamental problem, if we'd approached it the same way as the semiconductor industry did, is that we could put 10 of them on the head of a pin. ■

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Douglas Engelbart:

On Bootstrapping

I'm strongly embedded in a framework that I developed in 1960–61 and published in 1962 that's been underlying what I've been doing ever since. It's the concept of bootstrapping. If you're facing very, very complex organization or social or institutional changes, why not, as early as possible, get as far ahead in the computer age to support humans doing that? Which is why I call it bootstrapping—why not use the computer to help you make the transformations?

We're really trying to get that strategy going. That is leading to a lot of things. We're actually making headway in getting some large organizations interested in actually starting this kind of bootstrapping. The very first stuff of that is forming a common-interest community. It's an active, collaborative prototype.

I'm giving these three-day seminars, and here's all the stuff they go through, 200-something slides. It's leading to this whole bootstrap philosophy and saying organizational effectiveness is the goal, talking about paradigms and frameworks as being the basic problem, so any strategy for going after it has to accommodate these.

Also, the changes that are coming about are so many and so rapid. So we have to find new ways, because our old ways couldn't cope with that rate of change. In these new ways, things like pilot experimental groupings of people and new tools, that's going to be very important. There are so many dimensions to explore that cooperation among different people is important to learn like that. The vendors are going to have to start realizing—as well as our user organizations—that the time it takes to shift the skills and the methods and all of that to fit the best one, given, profile of functions, that's where our expense and the time are going to be. So [organizations] want to have a lot more cooperation between the vendors and the user groups, and the user groups have to get more active.

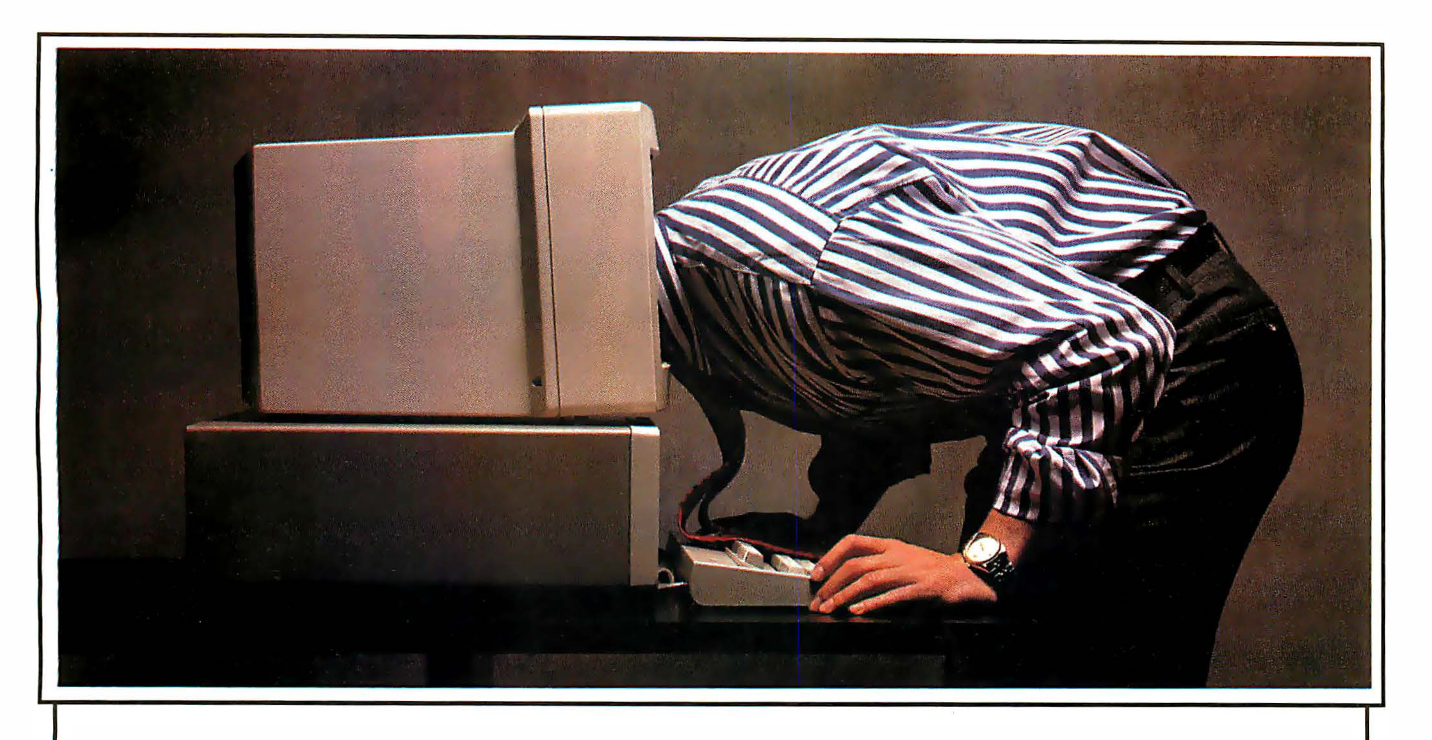
There's a special role for some kinds of groupware in that if we push that ahead faster, that will just help make the whole process go so much better. That's [why] what I call an "open hyperdocument" system is something whose payoff will just be immense, and it should be pursued real rapidly. And the fact that users aren't getting experience in that yet, and vendors aren't, so the better thing [is] to try to generate an environment in which that kind of experience could get accelerated so you can know sensibly how to aim for products and standards and—whew! That leads to the bootstrap community and what we're trying to get launched.

In the strategy, we're just saying, if an organization really is interested, here would be a way to get started: Join this special-interest community. You'd have to get active enough in it. It would be sort of a prototype way of working in itself. Here's the best targets of activity to use in it. So we have eight to 15 companies of different sizes who are external organizations.

There was a voluntary organization of a committee from among the representatives of companies who came to our seminar in January who said "Well, let's just draft a trial business plan." So now that is converging to a trial, so we're planning a meeting with any company that's interested enough—and government organization and university and vendor—to come together for a meeting to converge on some plan that sounds sensible enough and then go back home and see if it will [fly].

It's building up momentum in a good way. There's a rapidly growing movement in America on this total quality-management theme. Three years ago or so, the Department of Commerce announced [that] they were going to give an annual set of awards to organizations that best met the criteria they had been establishing for this quality management. More and more companies are saying, "Hey, we're going to go after that award." In the process, one of the [by-products] is a continuous improvement plan with lots of verifiable aspects. This strategy that I talk about wouldn't work unless there were some high-level, continuously present commitment in the company to make their changes. Otherwise, who's interested in talking about strategy? Heretofore, I'd try to talk about this, and I wouldn't know how to find someone in a company. Almost everybody is tied to some project or deliverable or bottom-line thing. So, that is a big change.

Editor's note:
See biography, page 236.



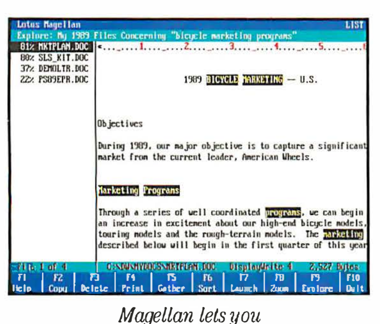
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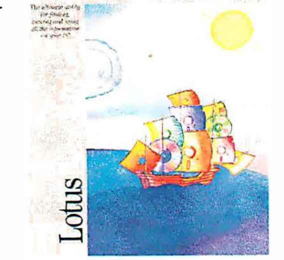
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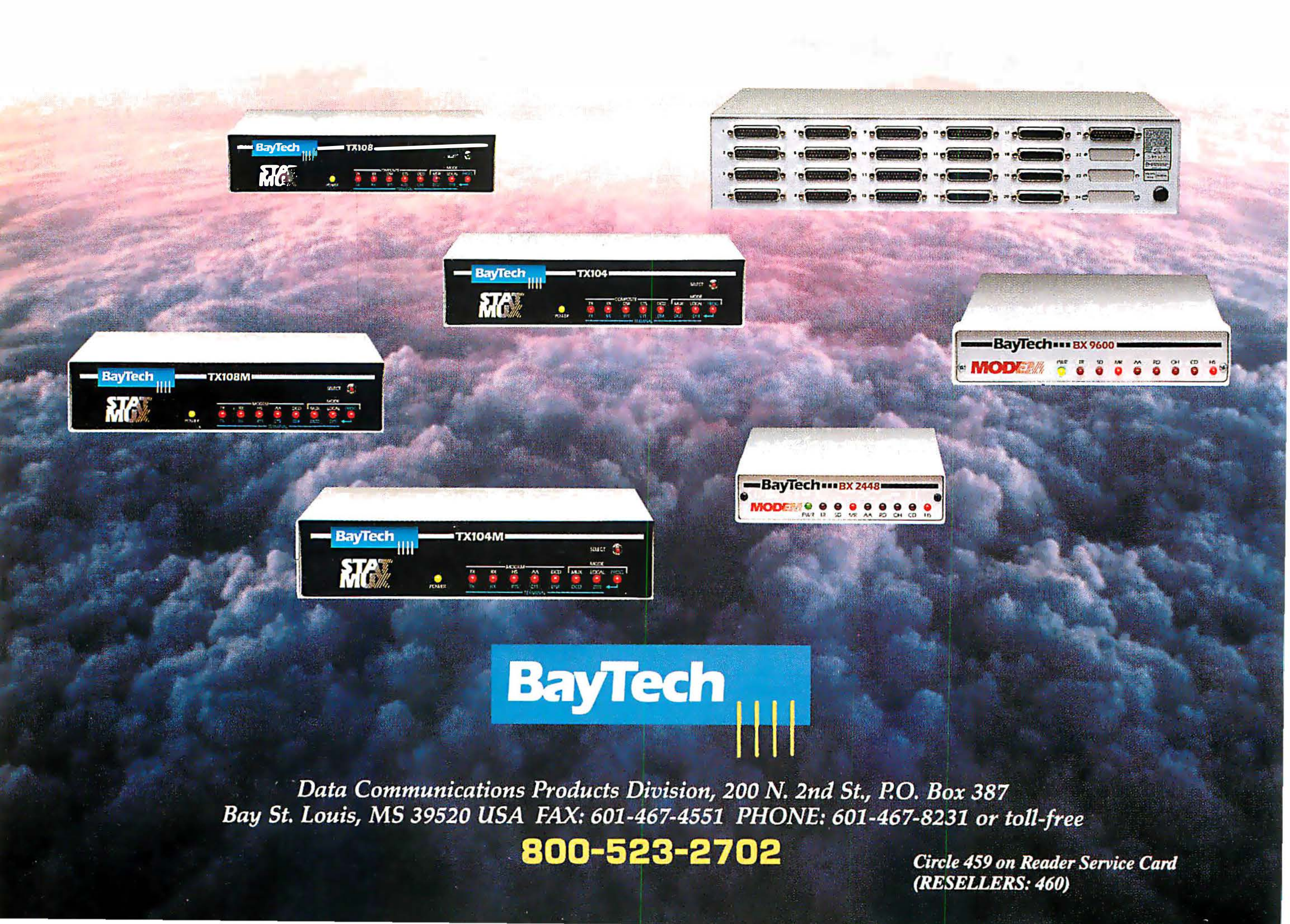
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What changes will we see in programming in the 1990s?



There has got to be a better way, and it's kind of halfway between programming and natural language.

—Esther Dyson

Bob Frankston: Programming is still bottlenecked in the expression of the ideas—or coding, to use a less grandiose term. We're going to be able to reduce the problem, basically make it easier to go from a design or conception to actually something that implements it.

Stephen Wolfram: I think one of the things that is part of the issue is what the building blocks for making software actually should be. Right now, most software is written in the C programming language or possibly some extension of that, and that's a pretty low level at which to create software. It's sort of interesting to think about, in general, how you can use high-level interactive symbolic programming languages to build general-purpose-type software.

Gary Kildall: I think that the actual brand-new language to replace something like C is really not necessary at this point, because C is sort of an intermediate—what I think of as an eye-level language and assembly language. And it seems to do the trick at that level.

Esther Dyson: But the real issue is what you do with the software and the model of the system, and stuff like that. And so things like object-oriented programming and all these other buzzy terms will probably get way oversold but, in the end, will probably really matter and be widely used. But they'll be so widely used that no one notices them.

John Kemeny: I still believe you have a great advantage with a universal language.

Bjarne Stroustrup: I think the idea of spanning the whole spectrum of programming with one language is absurd. It's like this strange notion some people have that there is one language that is the best for all people and all applications. It's crazy. Let's face it. It's like saying there should be exactly one kind of car and ignoring the fact that there's towns and there's country and there's trucks and there's fire engines, all kinds of things. Variety has its place.

Carma McClure: I think right now what we see [in] the first half of the 1990s are what I would call evolutionary—not revolutionary—changes to software development, meaning that basically the same languages dominate, the same methods still dominate, as have dominated our industry since—what—the 1970s to 1980s. You are still going to find languages like COBOL, for example, being the number one choice for developing business applications. And you're going to hear a lot of interest in object-oriented techniques, and a lot of people beginning to use them and beginning to learn about them, certainly—but I don't think they are going to have a real major impact until maybe three to five years from now. And I see them sort of infiltrating our methods, and you see the traditional structured methodology like Yourdon or something extended to include object-oriented. So, rather than giving the old ones up and replacing them, say with object-oriented techniques, we see them being extended to incorporate object-oriented techniques.

Alan Kay: I think the main thing is that there's no accounting for taste. The fact that COBOL is still around and going strong—even though it was obsolete by around 1965 or so, as far as a language with power [is concerned]—says something about the staying power of the familiar.

Esther Dyson: But there has got to be a better way, and it's kind of halfway between programming and natural language. Just as people don't think of themselves as telephone operators—they think of themselves as dialers—people won't think of themselves as programmers. They'll think of themselves as trainers, just the way I spent [six months] training my secretary. Every day new problems arise, and I show her how I want them handled, and sometimes I give her examples, sometimes I give her instructions. It's an iterative training process. So, in the same way, you're going to train your computer, both by giving it instructions [and] having it watch you, but it will just feel more natural. Ten years from now, people are going to say, "Oh, yeah, training your computer—that's so intuitive." And of course it won't be, but it will be taken for granted.

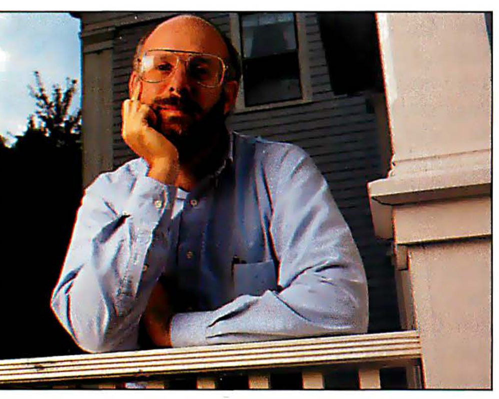
Carma McClure: I think [developing software] is going to get significantly easier,

continued

ILLUSTRATION: CATHARINE BENNETT



Dennis M. Ritchie is a member of the Computer Science Research Center at *AT&T Bell Laboratories*. He designed and implemented the C language and, with Ken Thompson, created the Unix operating system. He shared the 1983 A. M. Turing Award with Thompson.



Jonathan M. Sachs is an independent software developer in Cambridge, Mass. In 1981, he teamed up with Mitch Kapor to create Lotus 1-2-3. In 1985, he established the Sachs Foundation, which has been active in land preservation in New England and in Central and South America.

Ken Sakamura (not shown) is founder and director of the *TRON Project*, an effort sponsored by the University of Tokyo to develop and standardize computers of the future. The project has already developed a real-time operating system, standardized interfaces, and a 32-bit microprocessor chip set. Professor Sakamura is on the information science faculty at the University of Tokyo.

and I think one of the reasons will be that we won't be developing them from scratch, but we will [be] developing them from reusable software components—I like to call them software chips sometimes. And object-oriented methods are really the first methods that we have where the concept of reusability is really an integral technique within object-oriented. And so, that is another reason object-oriented is important and will play, I think, a more important role in the future—because it really fits with reusability as a development strategy.

BYTE: ***Speaking of object-oriented methods, do you think that's a real movement or a passing fancy in the industry?***

Ed Yourdon: I think the industry is just beginning a transition into object-oriented methodologies—I would say that that is going to be the big one in the nineties, as a replacement of the pure process-oriented methodologies, like structured analysis and structured design, and pure data-oriented information-engineering kind of methodologies. And that's something that I'm very much involved in right now, is the whole object-oriented paradigm, which I think the industry does need.

Seymour Papert: Structured programming is good programming. In short, what's being projected there is a way of thinking that mathematicians like and many engineers who are mathematical in their way of thinking like. But it's out of touch with the sort of thinking of very many people, including many mathematicians who like to think in a way that's much more playful, less planned, less systematically organized, more exploratory.

Paul Carroll: I don't know of anything that would be beyond structured programming or object-oriented programming. It does seem to me that object-oriented programming is a very powerful thing that will take hold, and people are catching on to the idea that prototyping really is important. We'll see far more of that.

Niklaus Wirth: I think designing in an orderly structured fashion is inherent to all good engineering design. So whatever additional style differences will emerge in the future, I think a structured approach is mandatory anyway. I look at object-oriented programming not as something dramatically different and new. There are one or two things that characterize object-oriented design, but, by and large, you work with the same concepts as you did before. It is not something radically new. [Except for] relatively isolated instances you can stick to your design methods that you have used before, provided that they are orderly and structured.

Bjarne Stroustrup: What's lagging behind is, of course, education. People get these great languages, and they come out of schools. They're taught how to write a procedure and to get real benefits of languages with inheritance, encapsulation—the good stuff. You need to start off thinking in a way that's appropriate to it. You have to actually do object-oriented programming, not just your old style of programming with the funny syntax. And that again means that you have to design your programs to take advantage of those facilities. So education matters a lot. Design matters a lot. And then you get tools that support that.

Bob Frankston: I tend to view things like object-oriented programming as overhype terms at this point. Yes, there's something there, but it's just a means, and it's just part of things.

Jerry Pournelle: In a sense, Modula was object-oriented before anybody knew what it meant. And basically what's going to happen is the popular languages are going to get more and more like Modula.

Niklaus Wirth: The crucial example is that when object-oriented preachers talk about numbers, for them numbers are an object of the class number. You can't add 3 and 4 anymore; you have to send the message to add 4 to yourself to the object 3. Now, this is certainly counterproductive, when you not only think in terms of computers, but it confuses people from what they have learned before. That would be counterproductive. Anything that you overdo is counterproductive. When such a new method comes up, I think one should learn to master that method and not become mastered by the method.

Stewart Alsop: The biggest advance I've seen has been the Interface Builder in NeXT—where I've seen real programmers, in a commercial environment, trying to make software for resale, actually find that they had a real gain in productivity: Not in a false sense of programmer A can write 800 lines of code a week instead of 400 lines of code a week, but in the sense that they can take an idea and get from that point to having working code that can be tested and polished in significantly shorter

continued

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The biggest limitation is the failure of imagination that people tend to project.

—Bob Frankston

times. And the reason the Interface Builder seems to have an effect is not so much that there's an object-oriented development environment, where you have componency you can hook together—which is part of it—but that it incorporates the notion of prototyping, as part of the development process, in a way that no existing computer language has [ever] incorporated [it].

Dennis Ritchie: One thing that seems to be happening is that people are getting away, to a certain extent, from the procedural sorts of things, which is independent of object-oriented and so forth. Maybe I'm being unfair, but basically, that's a refinement or a variation of the same need of procedural programming, a little different style. But there are languages that are much more involved in data-flow things where the order of events is not so important but the grand flow of it is that data is passing by this program. That's something that I think is likely to increase so that, to some extent, [you're] increasing abstraction. Whether all this will make programming, as such, much easier for the average user, I don't know. I tend to doubt it. It's hard to see that it'll really make a gigantic change. It's not clear that the average user really wants to be a programmer, anyhow.

BYTE: ***What do you think we mean when we talk about the average user doing programming?***

Bob Frankston: There's going to be a lot of empowering of the users in terms of programming so you'll be able to describe things better. I will give spreadsheets, of course, as an example of that, where the real thing is [that] you empower the user to take a description of the computer. There was a middle ground. The computer didn't speak the user's language literally, but there was a middle ground in which there was—I hate to be anthropomorphic—some sort of understanding. The key thing is, they both dance with each other. That's going to be more widely available as computers get the power in terms of raw MIPS, and then we're going to handle some of the software capabilities. How do you give the user the ability to describe sort of interesting processes?

Carma McClure: I can see where lots of packages go into the hands of end users where they take the design of the system and they play with the interface, and they change it the way they want it, and then they just generate the system that they need.

Chuck Peddle: This thing about the concept of the program generator that lets people tailor programs—I have a strong belief that that is going to be important. I'm really surprised it hasn't done better than it has. So, I think that is a place to be looking for—the higher-level, tailored, specialized application.

John Markoff: I think that we'll see tools that will permit the average user to customize applications. Those are already there, and they are going to get much better. Apple's coming with stuff that will be built into the operating system. ToolBook is coming for Windows. Those are major thrusts in that direction for the nonskilled programmer. For real programmers, of necessity, the evolution of the computer industry is prying people away from the machine. Because programs have to be portable, people can't program in machine language anymore. Usually, there is still a penalty that is paid for that in terms of performance, but portability is more important than performance these days.

Niklaus Wirth: I don't know what the average computer user is. A competent computer user should in the future be able to buy systems that he can relatively easily extend and adapt to his particular needs, if he has the competence to some programming. So good computer users will become capable of doing such extension—custom-tailoring—themselves. But perhaps that is not the average.

Gary Kildall: Usually, when you get beyond just the basic language, general-purpose language, you get into special-purpose kinds of things. What you're really trying to do is get a control language, and a language built to really express that particular application fairly nicely.

Stephen Wolfram: The problem is that introducing a new programming language is a serious kind of sociological problem in the sense that if you tell people, "We have this great new programming language," people will immediately say, "Look, we're not going to recode all of our billions of lines of FORTRAN code or C code, or whatever it is, in your great new programming language." And so, really, the only way to introduce a new programming language is in a kind of Trojan-horse type of approach: People start using it as an application program, but then kind of fall into using it as a programming language.

Gary Kildall: C and most other languages are basically what we think of as top-down programming languages. You start with `main()`, and you start writing the rest of your program from there. But most of the things that are happening in embedded controllers and microprocessors now are exactly the opposite. It's all from the bottom up. It's all event-driven. And C and most other languages do not have that [bottom-up] perspective.

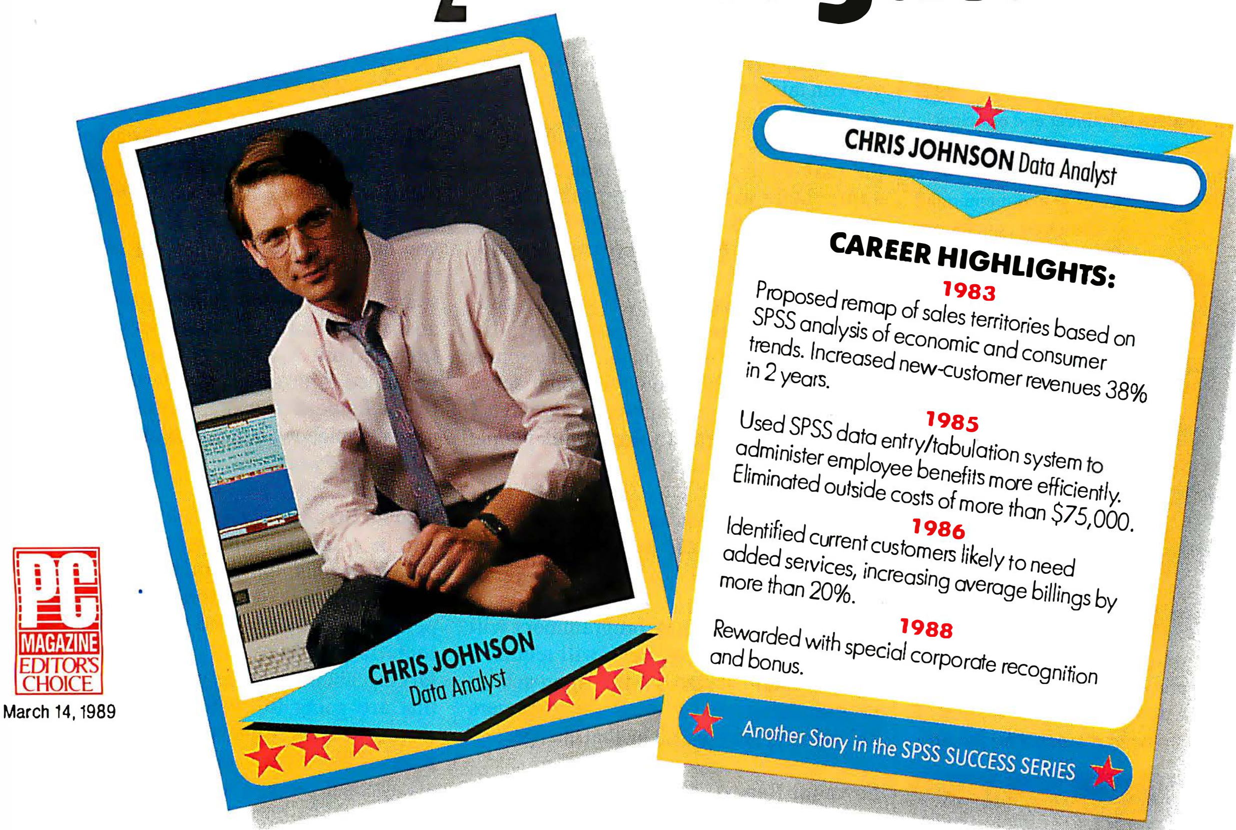
Stephen Wolfram: I think one really incredibly important direction in building software is going to be using higher-level languages. And I think the kinds of things one can expect to see happen in the next few years are things like being able to build graphical user interfaces and so on, using specification languages that are high-level symbolic languages, and being able to, for example, have some symbolic data structure that you can manipulate interactively that represents dialog boxes, windows, and things on your screen.

Gary Kildall: The improvements in the languages, I think, are going to be more oriented again toward some of the vertical markets, like scripting languages and things like that, where we'd have basic primitives that we build in something like C and just, you know, choose your favorite language. And then you build up languages that are really appropriate to the particular application that you are doing.

Bjarne Stroustrup: People talk about HyperCard and such things—that's programming of a sort. They still edit from a professional programmer point of view, but it's not meant for professional programmers. On the other hand, the casual programmer looks at something like C++ or even Pascal and says, "This is horrible. This is incomprehensible. It's useless. It's too hard

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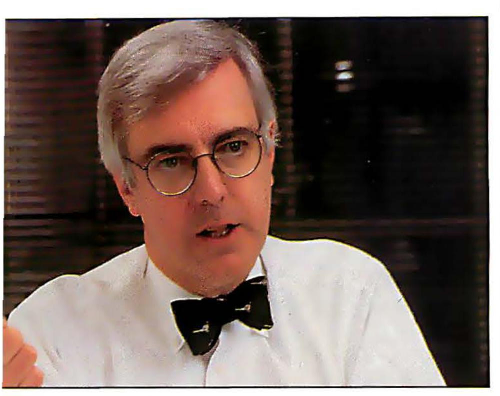
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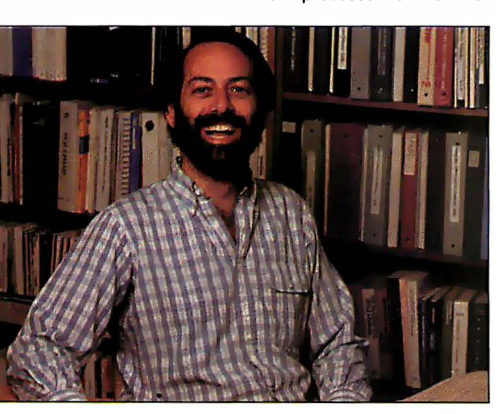
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Richard A. Shaffer is founder and principal in *Technologic Partners*, a consulting and publishing firm, and editor of *Computer Letter*, a weekly financial newsletter about emerging computer companies.



Charles Simonyi manages the development of application programs for *Microsoft Corp.* At Xerox PARC, he developed the first WYSIWYG word processor for the Alto.



Michael Slater is editor and publisher of *Microprocessor Report*. He also organizes the annual Microprocessor Forum conference, consults on microprocessor strategies, and conducts training seminars.

to learn." It wasn't meant to be learned in 2 hours by a casual user.

Brian Kernighan: I think what we'll see perhaps is that the set of tools that are available to people are more and more flexible so that people will be able to tailor them to particular jobs, so that you could imagine that they're kind of like programmable tools. But the transition from not programming to programming should be very smooth—where the program may do almost what you want right away, but, if not, you can fairly easily adjust it so that it does.

Paul Carroll: I don't think we will see in the next 10 to 15 years lay people do any appreciable amount of programming. I think they'll do a little customization of their software, because software developers will be able to cleverly hide that complexity from people. They'll just run people through a series of menus initially asking them how they want to handle something or other. You could in some sense think of that as programming, although I guess I don't. I certainly don't think people want to go beyond that.

BYTE: ***What kinds of changes do you think we'll see in the jobs that programmers do?***

Stewart Alsop: I think programmers will become more efficient, but it will require a fundamental change in the approach to programming, and a lot of programmers are going to get waylaid by that change.

Seymour Papert: Many of the kind of programmers we used to call hackers (before the days when *hacker* was taken as a disreputable word) don't like to program in a structured way. They like to make something, maybe quick and dirty, that works. That's another way of doing computation.

Stephen Wolfram: I think also that the notion of who's a programmer and who isn't a programmer is going to get considerably blurred. It's already something that's happened a bit with macros for [Lotus] 1-2-3, and happened—perhaps less than was hoped, but happened somewhat—with HyperCard. And I think that, increasingly, what one will see is higher-level languages where writing in them is not so much thought of as being programming. I think part of people's feeling about programming is [that] programming involves doing all of this quite obscure, very machine-oriented stuff, and that will be decreasingly true.

Bill Gates: Programmers are always the professional people who might get at things in a different way. But these visual tools—these object-oriented tools—they are fundamentally the tools we're going to use. The C of the eighties is C++, with a library of objects including visual objects and application objects. It means that huge portions of what you had to code before—the user interface pieces—are very easy to change how requirements work. You don't have to program all the algorithms about how you do resource allocation or what logic to use or how to categorize things.

Niklaus Wirth: No, I think programming will always remain important. I still remember 30 years ago when a colleague at Stanford asked me, "Can you imagine that you at 50 will still [be] doing programming? That's nonsense, you will move up somewhere. That is detailed, grutty work," and so on. And I have, together with a colleague, built a whole system, and I programmed it myself, and I really enjoyed [it]. I found it terribly interesting, but it needs, somehow, a technical mind to enjoy this kind of work.

Bjarne Stroustrup: I think that the world will be split up in what we call professional, or serious, programmers and casual programmers. If you look at history, then, people have always been talking about automatic programming. They have been talking about these grand new languages that are going to eliminate the programmer. It's always just the next technology around. But if you look, programmers have always been there. There has been a certain skill to it. To do a really good program, you have to know an application area, and you have to know something about the craft or engineering. If we're pretentious, or maybe if we've learned a little bit, we need both there.

John Kemeny: I still feel very strongly that learning how to program is an essential part of understanding computers. I don't mean someone who is just going to use it for word processing. But if you are going to do any serious work on computers, you really ought to program once in your life. I've even argued that if they are never going to write a program later in their life, the experience of writing a few programs, and particularly the experience of trying to debug programs, is a terribly important experience in understanding computers. Without it I don't think people have a feeling on how much they should believe of what comes out of a computer. ■

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INSIGHTS

Chuck Peddle:

On Microprocessor Trends

Because of the enormous installed base on the 8086 in the PC world—you've got a number estimated at 40,000 useful programs that are in general-purpose circulation, that use that architecture—for some relatively long period of time, probably through the end of the century, the continued supporting of [that] installed base will be terribly important to the marketplace. There's a bunch of ways you can get that done that are not necessarily buying the latest, hottest product from Intel; but, clearly, microcomputer systems, as opposed to necessarily microprocessors, are going to include some member of [the 8086] family for a long time.

Having said that, the next major thing that is driving the marketplace at this point is the fact that with the ASIC development tools that are available today, and the compiler generators, and the higher-level-language kinds of programs that are going on and everything else, you're starting to see a family of what I call "customer-design general-purpose microprocessors" occurring in the marketplace. And they are really super-ASICs. SPARC and MIPS meet that definition.

They're not strong enough and general-purpose enough, and cheap enough, and so forth, to have as broad a market following as, say, the 6502, or the 8088 or whatever. But they definitely have enough general-purpose application that multiple people will use them, and there is some level of support for them. So, that's a definite market trend. I think [that] you will continue to see that super-ASIC with some level of general purpose, and I think this will probably be where we get the richness of the development. I think we will see just a ton of those coming out (a ton being some number greater than 10).

And to the extent that, if Intel continues on the track that they are on—of forcing the marketplace to pay higher and higher prices to Intel, who is then, at the same time, undercutting the very guys that are buying from them with their own end-product applications—there definitely is going to be some sort of marketplace rebellion against the level of control that Intel has. The rebellion won't be [an] overt "I won't ever buy another Intel chip" kind of thing. It will be that [vendors] slowly reverse this trend by building in some version of an Intel processor and putting in multiple general-purpose control processors for which they write all of their code. And they don't write any more code for the Intel processors themselves. And they use the Intel processors more as a compatibility tool, à la the 1401 simulator on the 360. Over a period of time, maybe a decade, you reduce the dependency on Intel as your only supplier.

Now, clearly there are some guys who are not going to take that strategy. The problem is that they are the guys who are always going to be bitching about [Intel's] price point and performance, and everything else.

The Importance of Memory

[On another front], the low-cost control-oriented product has not kept up with the growth in memories. They really haven't done it. What I am saying is that there isn't a family of products that are aimed at memory-intensive, higher-performance control. Some people talk about a SPARC doing that: It's the wrong solution. The SPARC, because it was a custom, was aimed at solving a problem of, "How am I going to get Unix running quickly; how do I run this C problem?" and so it is tied to memory in a funny way. And it's really not the right answer, but it is the best one around right now.

And I really believe that that's a tremendous market opportunity. I hope we will see some number of general-purpose guys continue to play in the marketplace, but solving a problem different than trying to take Intel on head-to-head. And I think if they don't, they lose.

Memory technology continues to drive the processing capability we've got. So I think you are going to see the real focus on getting memories that are good enough to keep up with some of this processor capability and system capability. I think that is where you are going to really see a lot of the inventiveness.

If you wanted to make a general comment on the most important difference in the [last] 15 years, it is that the amount of money that's on the table in the industry, it's so big that it changes the rules from 15 years ago.

The Payoff

I think we have to back off and ask ourselves what human beings need. What's the human's problem? Human beings need different things than we are driving for right now. And [that is] the other half of the thing I'm doing. I think that there is a human solution for how you use a lot of this technology that nobody else is working on. [I take that back]; there's too many people in the world to make that [broad a] statement.

A lot of people aren't writing about the solutions that I think people need. I think that's important. I think that that is where the applications are going to come from.

What do human beings need to do next? I think I know the answer, and that's what I'm working on. We are in the process of financing a company that has a chance of making a major market breakthrough, and we'll let you know if we get it financed.

Editor's note:
See biography, page 325.

Ryoichi Mori:

On Superdistribution

I believe that the most fundamental breakthrough that will have huge effects is the realization of the smooth distribution of digital information. If we could establish a microelectronic method to achieve this breakthrough, then it would have the effects [on a scale] comparable to the breakthroughs that made the mass production of computer hardware economically possible.

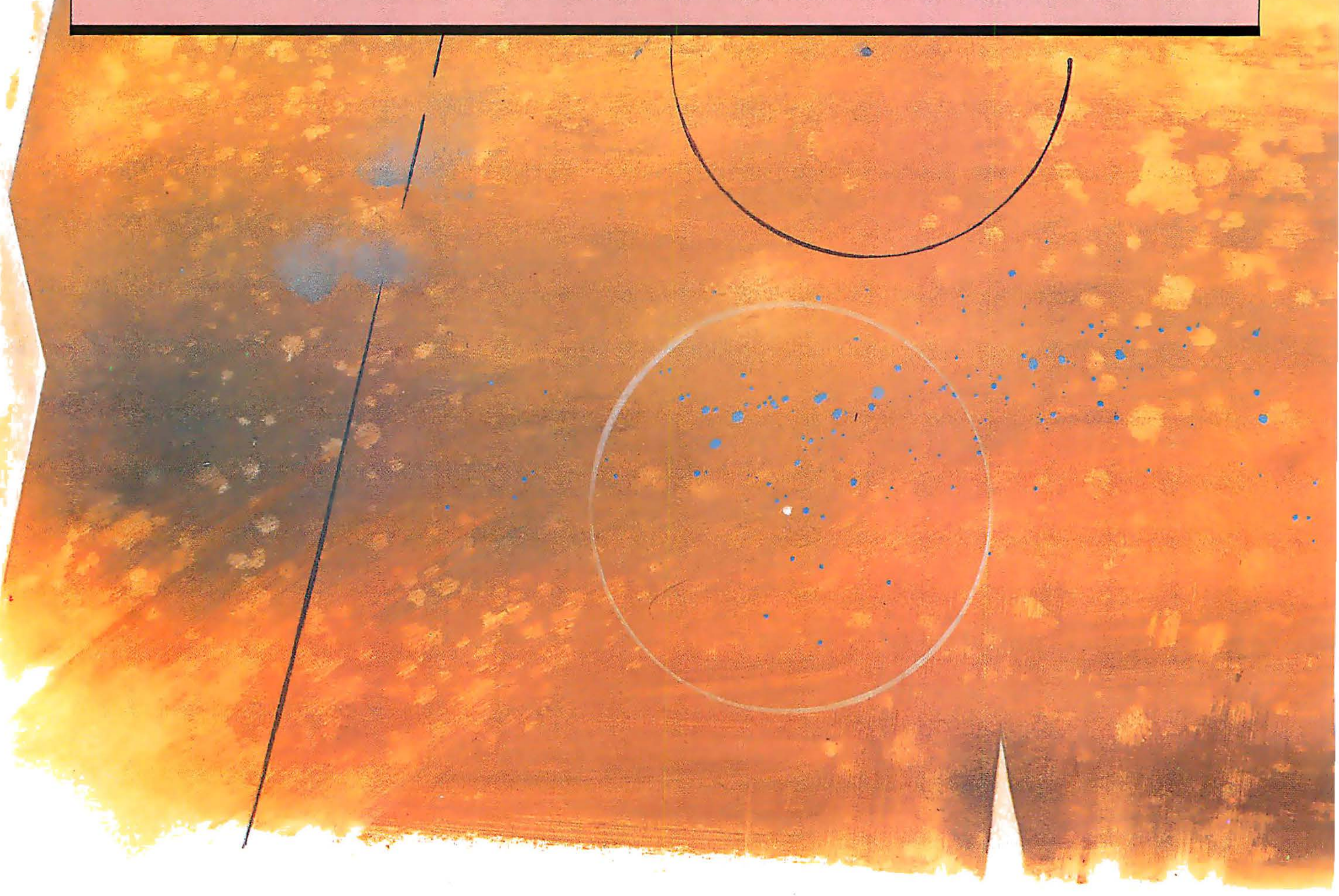
I have been proposing a concept—superdistribution—to realize the breakthrough. Methods to realize satisfactorily fair transactions of digital information either place limitations on the actions of users (e.g., prohibit the copying of information) or keep and collect usage records that hold who has used how much of what software.

Limiting the actions of users has proved very unpopular. It prevents the healthy growth of the software market. It is also widely recognized by most software manufacturers that it does not provide more profit for themselves. Therefore, the collection of usage records is the only way to realize satisfactorily fair transactions of digital information. Then the task for us is how to realize it by making the generation and collection of the usage records as comfortable as possible so as to be accepted by the users widely.

For the next 10 years, there is little doubt [that] the semiconductor integrated circuit technology [will] keep the same rate of progress—that is, an increase of the integrating density of four times [for] each three years (1.6 times every year).

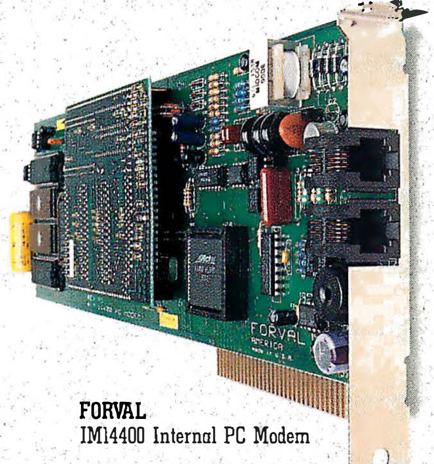
If this prediction is right, social needs for the microelectronic technology to provide the smooth distribution of digital information will become very strong. The reason [for this] is that the needs will become stronger as the scale of the software—or computer—market grows, and the cost of the microelectronic measure [needed] to realize that smooth distribution [will go] down rapidly.

Editor's note:
See biography, page 304.



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Esther Dyson:

On Computers and Eastern Europe

I don't think you can go into the Soviet Union and Eastern Europe and make deals with the state-run corporations, with the industries that employ 60,000 people, 58,000 of whom are paper pushers. I think that's the wrong way to go about it. Compaq, for instance, is dealing successfully with individual dealers in Eastern Europe.

I think computers will be an important agent for change in Eastern Europe. In the Soviet Union, for instance, you find many people setting up their own businesses—selling T-shirts, or farm produce, stuff like that. Now, with computers, you're getting the intelligentsia involved in businesses. These are people who have felt useless—useless—all their lives! Do you know what it is like to feel useless all your life? Computers are turning many of these people into entrepreneurs. They are creating the entrepreneurs these countries need.

Computers are interesting and exciting. [That's why] they're important. If you're a trained engineer, you don't want to sell shoes, but you may find it exciting to sell computers. There is an excitement to computers that you don't find in other areas.

I have done a lot of traveling in Eastern Europe recently—Hungary, East Germany, the Soviet Union. (I will never confuse Budapest with Bucharest again.) I'm organizing a conference, The East-West High Tech Forum (Budapest, [Hungary,] October 21-24, 1990). I want to be the Ben Rosen of Eastern Europe—not by supplying capital, but by bringing people together and supplying ideas and knowledge.

The revolutions [in Eastern Europe] weren't brought about by computers—I think television was far more important in bringing about the changes—but I think that computers, the computer industry, will play an important part in the economic revolution that will take place over the next 10 years by providing the entrepreneurs [that] these countries need to develop true market economies.

Editor's note:
See biography, page 236.

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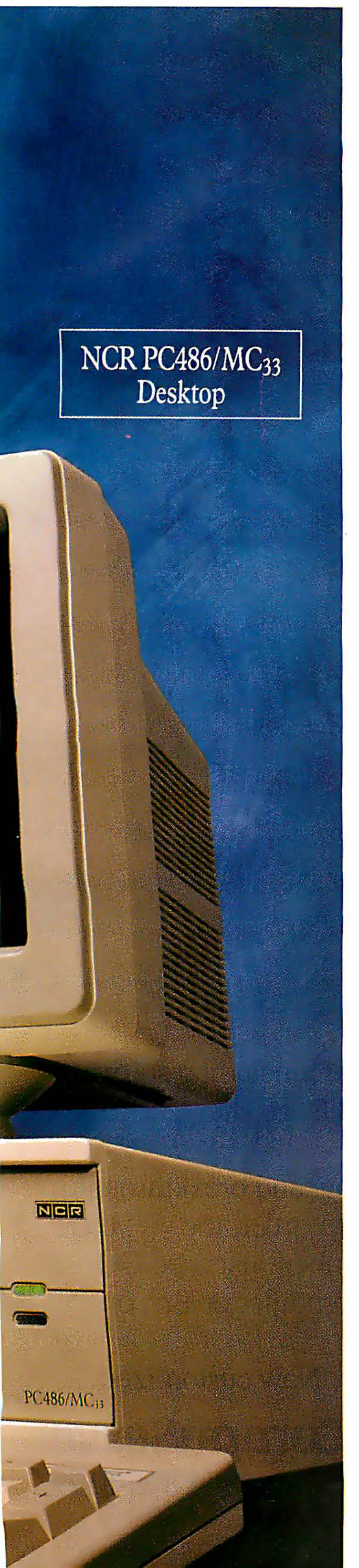
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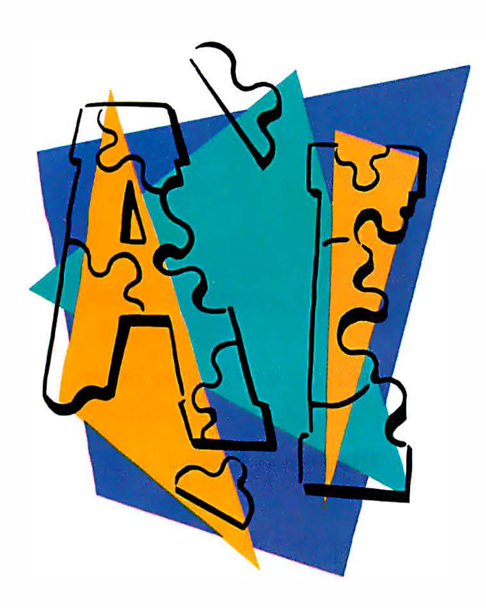
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BRAINTEASERS

Why have we failed to come up with "real" AI?



Robotics and expert systems were easy by comparison to really understanding intelligent behavior and learning at the very early stages.

—Nicholas Negroponte

Danny Hillis: Partly what I think is holding it up is [that] it's an extremely hard problem. We should not expect it to make progress in five years, or 10 years. It is fundamentally one of the hardest problems we've ever tackled. It's like the problem of understanding the mechanisms of life. And people aren't surprised that as soon as we got microscopes, we didn't understand life within five years. We're still understanding it. We still only understand some of the very simplest things.

Jerry Pournelle: It's just tough—a damn hard problem, that's all. We don't know the algorithms. We don't even know whether or not we're on the right track to get the algorithms.

Jonathan Sachs: I guess I'm not one of the people who say that computers will never achieve intelligence, but I don't expect it. I think it's a long way away, and they have to become a lot more powerful. There's a conceptual barrier that has to be broken where, somehow, you can write a program that is then capable of learning and becoming smarter than the person who wrote it. I think there's a qualitative difference between that and anything that exists now.

Seymour Papert: A small part of intelligence is called stupidity, and AI will go through this necessary phase. In the early days, though, we dreamed about big problems. A big problem is thinking about the nature of intelligence. Once you could make a little system that could pay off, it could be used in the real world. But it drained off energy thinking about small problems. The long-term goal/problem is to make a really intelligent machine. But it may be the next generation before we can.

Dick Shaffer: The role of machines is to do work for humans. Can you imagine if in 15 years or 500 years, people are parading in the streets, and instead of saying, "Do not kill animals, don't wear fur coats," they're saying, "Be kind to your machine"? I don't think I'm prepared for that, but it's not irrational.

Nicholas Negroponte: The reason we have, so to speak, not produced the results in AI that people talked about is, in my opinion (and believe me, this is *not* shared by many people), that the AI community, about 10 years ago, started to work on the easy problems and sort of abandoned the hard ones. They started to work on robotics and expert systems, which were easy by comparison to really understanding intelligent behavior and learning at the very early stages.

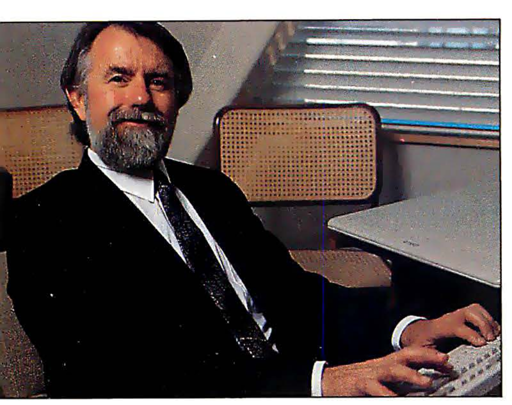
Paul Carroll: Most of the initial efforts in expert systems were misguided. They were trying to duplicate everything that one incredibly astute expert in one field knew, rather than tackling systems with broader applications—customer service or something else. People have changed their focus, and the work done in AI from now on will be more profitable.

Rich Malloy: The problem is just that you're forcing one processor to do too much, and it's just overwhelming in the AI world. In the neural networks, you're balancing things over a much larger number of very simple processors and therefore able to do more complex things. But I think the problem is not so much in AI, but the promise that was hyped about AI. And that's just [that] people got carried away with it. But there are some benefits. There are some good expert systems that have resulted, and there's some good work being done. But a lot of the things that were promised about AI will probably end up being accomplished with neural networks.

Federico Faggin: One problem with AI, in my opinion, was the approach of relying too much on logic. And the second thing, [which] is secondary, is that the computation power required to solve [the AI] class of problem is enormous. And it is enormous whether you use the old method of AI or the new method of neural networks. You need a form of computation that relies on learning, and learning as things change in the real world without supervision, without anybody telling the machine what to do. All that AI has pursued is to break down a problem into its logical parts and components, and on and on and on. That's what neural networks are bringing—which is new—the notion that you don't have to program in the kind of traditional way and try to use logic. Although that does not mean

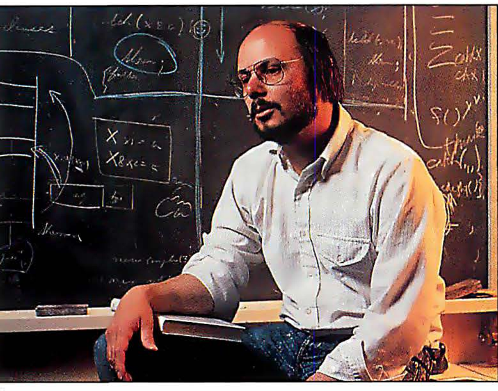
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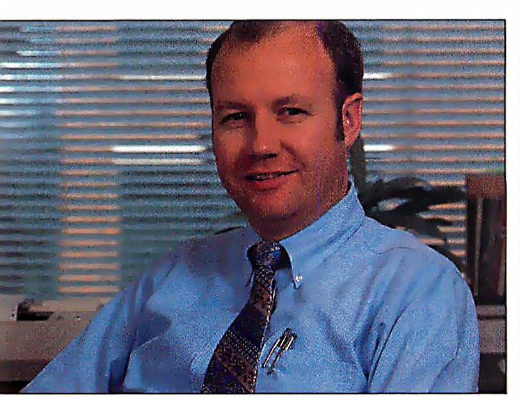


Alvy Ray Smith is cofounder and executive vice president of *Pixar*, maker of the RenderMan 3-D graphics system. He has also been director of computer graphics for the Computer Division of Lucasfilm Ltd.

William Stallings (not shown) is an independent consultant specializing in data and computer communications. His book, *Data and Computer Communications, Third Edition* (New York: Macmillan, 1990), is the standard text in the field.



Bjarne Stroustrup is a member of the Computer Science Research Center at *AT&T Bell Laboratories*. He designed and developed the original implementation of C++.



Jonathan A. Titus is editorial director at *EDN Magazine* and *EDN News*, which cover the electronics industry. He is credited by Robert Noyce and others with developing the first personal computer, the 8008-based Mark-8, now on display at the Smithsonian Institution.

that logic is not an appropriate thing. Logic is very appropriate for a certain class of problems, [but] not for all of them.

John Markoff: In the seventies and eighties, the model was just wrong. They were trying to mimic things that humans do. Expert systems that just basically use these decision trees that are stepped through—they have some utility, but it had nothing to do with the way humans think. I think the stuff that's going on in terms of neural research and neural-net computing is probably much more promising, and it will be very interesting to see what comes out of that. They're going to be successful at making machines that can understand the human voice. Vision is going to make a lot of progress. But it'll come because you've basically got a new model of how humans function.

Danny Hillis: I think that to me, artificial intelligence is making progress at a pretty respectable pace. In fact, we are learning quite a bit of stuff. I think we'll learn a lot more over the next 10 years. It will become more popular in 10 years, and it will become less popular, and so on—it'll wax and wane. But it's a problem that I expect to spend the rest of my life working on.

BYTE: ***Do we understand enough about the human brain to mimic it with computers? And if we do, do we have enough CPU power available to do it?***

Paul Carroll: CPUs need to become more powerful to facilitate developments in AI. I'm intrigued by a book that Roger Penrose wrote, called *The Emperor's New Mind*, in which he argues that people, in fact, don't understand the way the brain works, and are quite far from understanding the way the brain works. Without running through the whole thing, he argues persuasively that computers can only handle things that are computable, whereas the brain has ways of handling things that are noncomputable in the classic mathematical sense. He says that until we figure out ways to incorporate those noncomputable attributes, we will never be able to get a computer to duplicate the brain's process.

Dick Shaffer: I think we have come up with machines that outperform people in many significant areas and will continue to do so. But we will not in the foreseeable future build machines that out-think the brain, for two reasons: (1) It's not worth doing, and (2) we don't know how. At a very fundamental level, we do not know how the brain works. We can't come up with programs that at a behavioral level have the same results, the same output. What happens in between we hope is irrelevant. We haven't been able to produce specific results that are indistinguishable from those that people get to by thinking. At that level, we can do things that seem intelligent, but that's not what most people really mean by thinking.



At a fundamental level, we do not know how the brain works.

—Dick Shaffer

Paul Carroll: People tried to tackle the entire problem all at once rather than breaking it off and doing it in bits and pieces. People went through the logic that Turing went through or the logic you find laid out in Hofstadter's *Gödel, Escher, Bach*, and decided [that], because we can do a mapping of a logical system onto a machine, therefore we can have a computer think the way a human does.

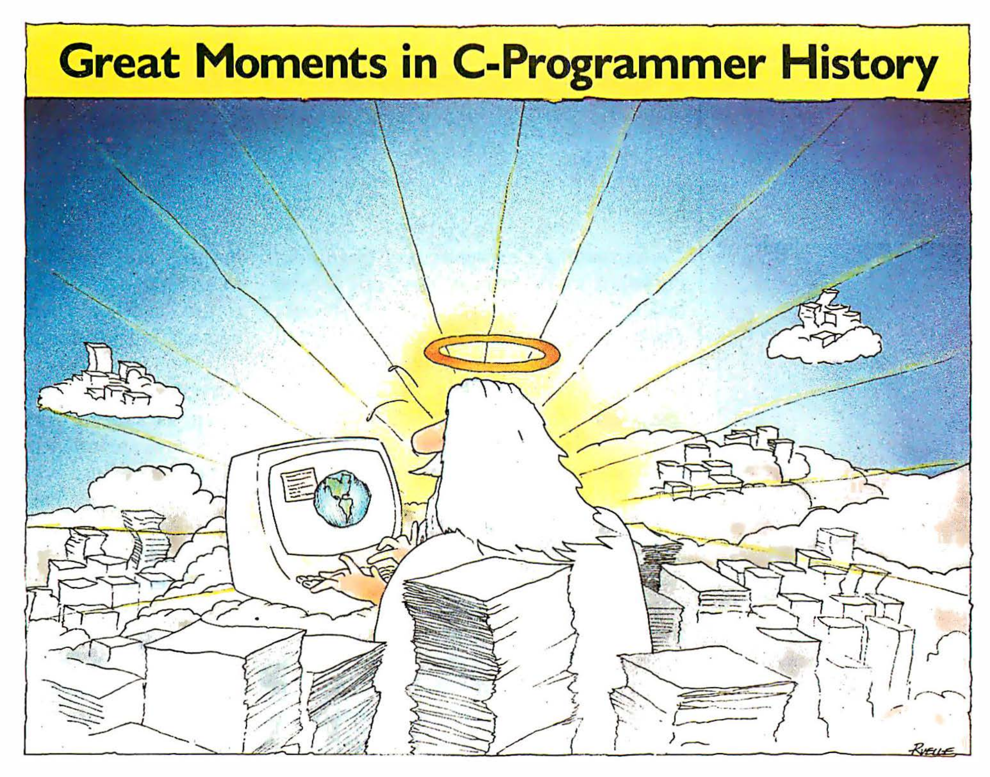
Seymour Papert: There are two obstacles in AI. Logic is the first one. It looks for a uniform approach: one thing that will be *the* secret—*the* clue (e.g., back propagation, etc.). But there is no single theory about how the mind works. The second obstacle for AI is that it became a victim of its own worldly success. In the sixties, people had a global goal of big intelligence for big problems. You can't make the *Society of Mind* in small systems. You have to have really big systems.

Danny Hillis: I think, certainly, even the most powerful computers today still fall far short of the information-processing bandwidth of the human brain. And I also believe that even if we had infinitely powerful computers, we still don't have a deep-enough understanding on how intelligence works to solve the problems. I believe both of those are holding it up.

Terry Winograd: This is right up my alley. One of the books that I've written,

continued

A. R. SMITH PHOTO: MITCHELL RICE
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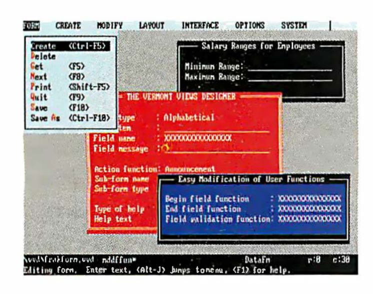


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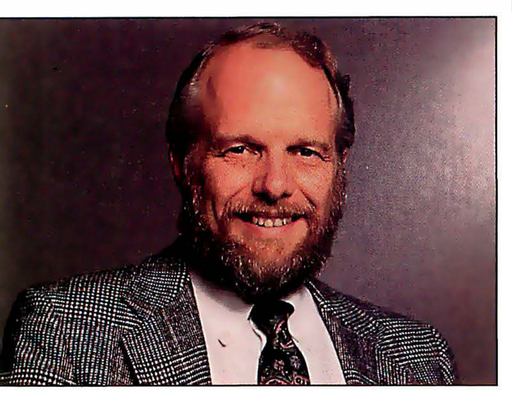
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John E. Warnock is chairman and CEO of *Adobe Systems, Inc.*, the company he co-founded in 1982. He has been a principal scientist at Xerox PARC.

Understanding Computers and Cognition, published by Addison-Wesley, talks about lack of basic understanding of how thought works. Some people think we don't have to understand how the brain works. That may be true in certain respects. Computers certainly do arithmetic better. The natural-language systems we have now can put language understanding in the broader sense.

Nicholas Negroponte: [Natural language and speech input] should become practical realities tomorrow, because speech input does not require natural-language understanding. There is a certain amount of speech control that does not require natural language. One of the things that have screwed us up a bit is that we have always coupled speech production and speech recognition with natural language.

Jerry Pournelle: The problem with natural spoken languages as they stand [is], "Time flies like an arrow," and "Time wounds all heels," and "There are flies on the fruit." You don't have any problem juggling all of that. We can understand [those sentences, but they are] very difficult for a computer to understand. And I really wouldn't want to predict when it will be that a computer gets sufficiently complex to figure that out.

Nicholas Negroponte: There is a lot of room for speech I/O that we can do [that will] make computers much, much more interesting to use without getting into the other kind of what I'll call "transcription," where you're trying to go from the utterance to a full understanding of the text, at which point it doesn't make any difference whether it came from speech or typing.

Danny Hillis: There is a big difference between understanding a sentence well enough to access a database and understanding a sentence well enough to judge good poetry from bad poetry. At what point do you call the problems [of natural-language understanding and speech input] solved? I think that in some simple ways they'll be solved and put into practice in the near future. I think they already are in some very simple ways. And it will continue improving over [the] decades. ■

Gordon Bell:

On The Computer Museum

I'm really excited about The Computer Museum [Boston, MA] at this point because its [latest] exhibit is a thing called a Walk-Through Computer. It's a many-times life-size computer. I mean, the monitor is, I think, 20 times real life. And it's got a keyboard and some keys and stuff like that, and you go in through it and look at it and see a blown-up version of it with traces and green boards and all the other stuff.

Then you go through a bunch of different stations. For example, you go to the CPU, and the CPU is sitting there with a projection TV, about a 36-inch television set, and there are three views [you] can have of [the CPU]. One view is what's happening at the electron level: watching voltages change on the various parts of the chip. The second view—there may be a 1's and 0's level, I'm not sure—but then the next view is of instructions moving around to carry all of that. And then the highest level is this manic view of the application [that the CPU] happens to be running. The application is a program called [World] Traveler, and you pick two cities, and it then builds a map for you and gives you a slide show of [points in between]. It's all done in MacroMind [Director].

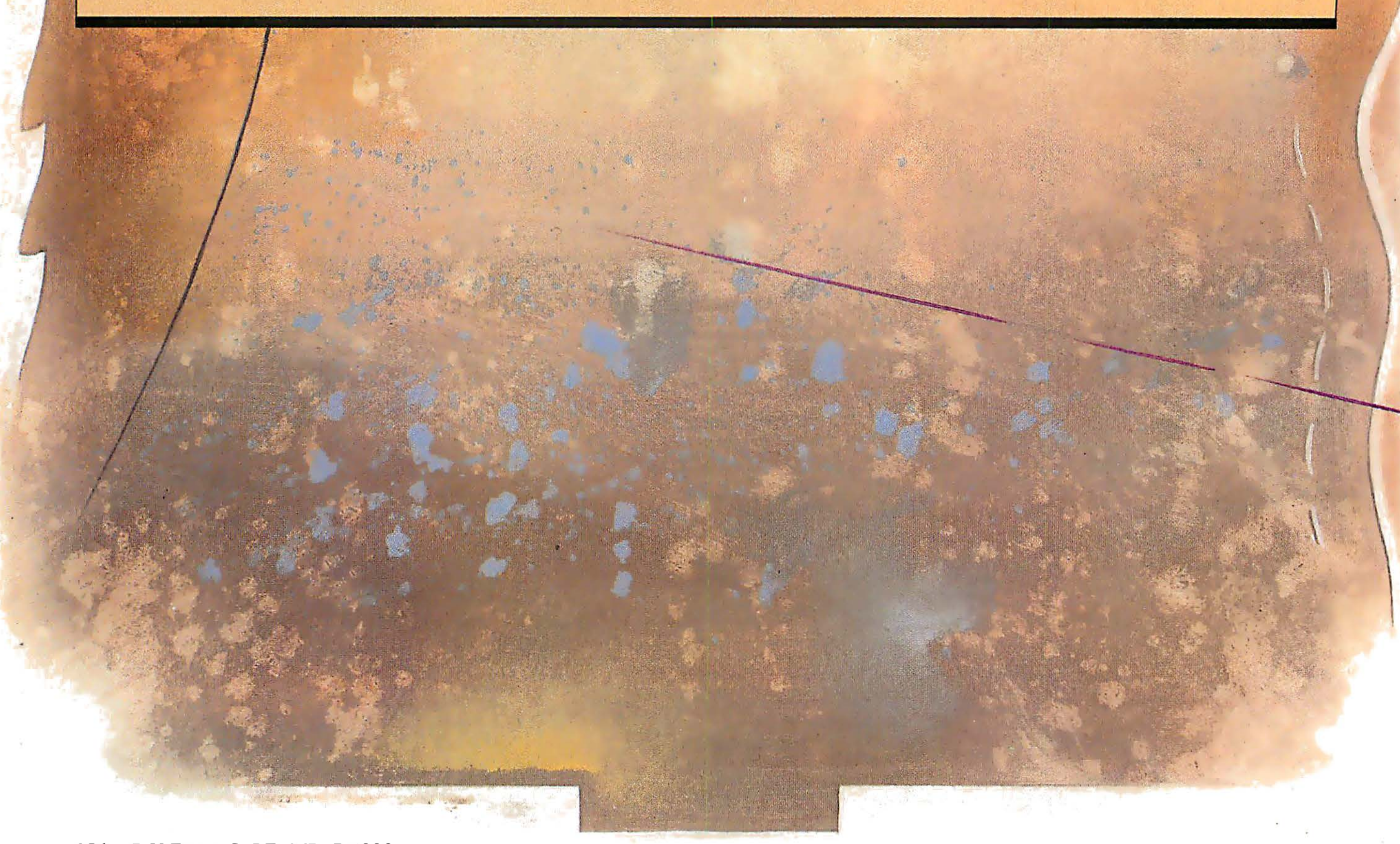
You can go to the little disk station and find out how 1's and 0's come off that, and what the commands are, and move to [higher levels]: "Get me a block, and get me a picture." And so you see all of these levels of how is it really doing it.

It's a huge exhibit. I think altogether it's a little over 5000 or 6000 square feet.

Mitch Kapor was a major donor to this exhibit and got it going. The Sloane Foundation was a major giver. A lot of companies gave both parts-in-kind and cash, so it was about a $1,000,000 exhibit. The neat thing about that exhibit is that [it] can be reproduced. That'll probably cost on the order of $200,000 to $300,000 to reproduce. It's a beautifully done exhibit.

Ken Olsen and I started [The Computer Museum] at a Digital building in 1979. And then we quickly formed a nonprofit public institution. And so I think the museum is really happening now. The Smithsonian just opened their information exhibit, and it's got a lot of computer things in it. It's got a lot of artifacts, but it doesn't focus on the computer the way [The Computer Museum] tends to.

Editor's note:
See biography, page 228.



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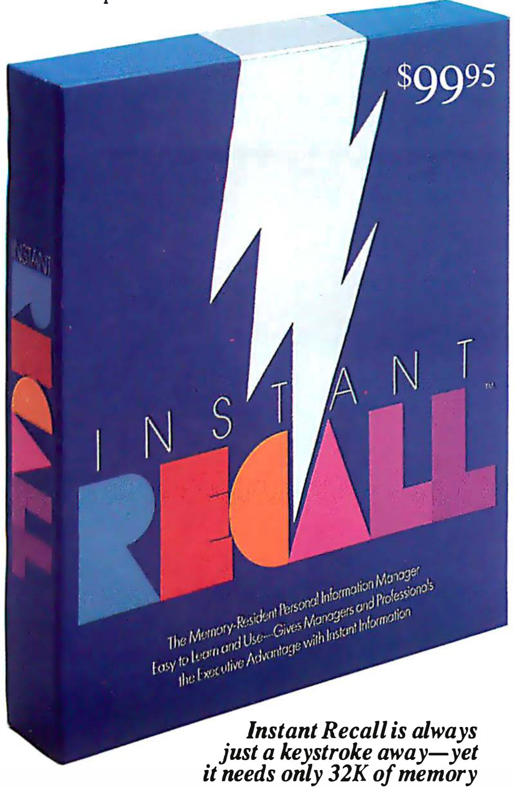


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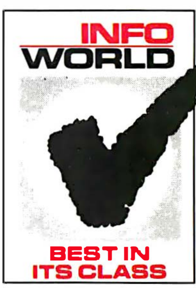
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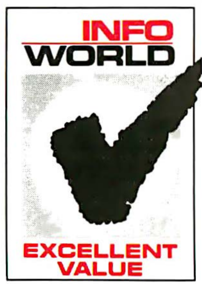


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BM09

Carma McClure:

On Object-Oriented Technology

If you look at it, the smart programmers—the really productive guys out there, the guys that are four or five times as productive as somebody else—have been using reusability as their secret weapons. It is practiced all over the place, but it is not practiced on a corporate or department level for the most part. And what we are going to see is it [being] raised up to that level, not just the private domain of a few very fast people—very productive people—but really a standard way of doing things. And a repository is the thing that is going to allow us to manage [reusability] in the integrated tool environment, to [make us] able to take advantage, take it out, analyze it, modify it, understand the impact of change, and all that business. And it is really going to [enable] higher levels of reusability. I am not talking about reusing a subroutine or a macro but a design specification, the architectural structure.

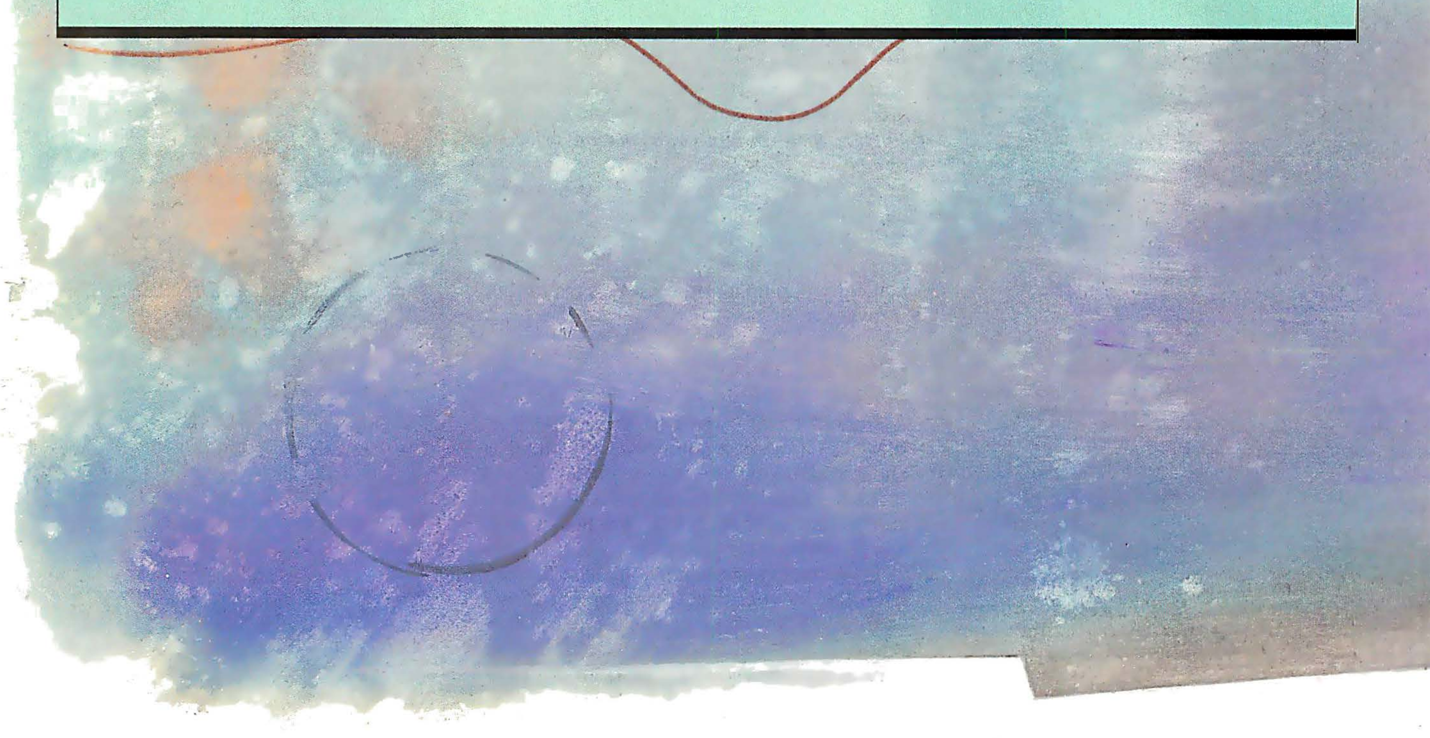
I think that some of [the resistance to object-oriented technology] has to do with [the fact that] it's immature and it is still developing, and people are having trouble saying, "Well, what is it: Is it a language, is it a technique, is it a methodology?" And most people would say, "Hey, it is not a methodology, it is a technique," or "It is a way of looking at things." And I think that as you get into the use of workstations and PCs and the wonderful graphics we have, we are going in a direction of using more and more graphic techniques to develop systems. And our tools [will] use graphic techniques. Object-oriented [technology] fits in perfectly with that kind of view of the world.

What's the biggest obstacle to [getting] there? I think it's people. You can't succeed with any of this unless the organization is ready for it. It means from the very top you have to have management support, give people time [to] change. People are always going to resist change, so you have to make this something that is exciting, that is attractive, and something that they feel they need and that they really must do. So a lot of it comes down to really a management issue, a training issue for the people.

In order to move toward what I call higher levels of software automation in the future, you are going to be using more standardized systematic-type procedures for developing software systems; there is no way around that. You can't automate unless you can define and pin down the process, and so you have to get people to accept that and have a different view on where the creativity lies.

Creativity is really in solving the problem for the user; it is not in transforming a detailed design spec into the best performance code. So you've got to change that perspective on it, and I think that is going to be the hardest thing. I think it's getting the people prepared and ready to change, training them in good skills, like analysis skills, communication skills, and problem-solving skills.

Editor's note:
See biography, page 292.



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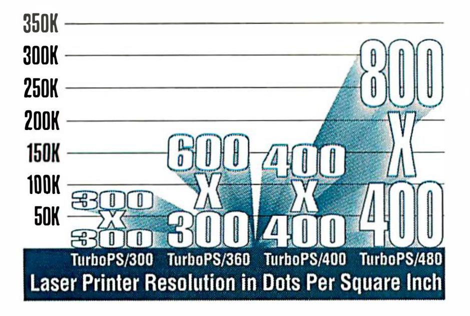
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Andy Bechtolsheim:

On the Acceleration of Change

What's exciting to me is that the rate of change—the curve—is accelerating. It's sort of a [feedback] cycle where we have these workstations—every engineer at Sun has their own SPARCstation now—[with] very good design tools—CAD tools—on [them]. People can just design better machines because they have better tools. Once we use those machines, we can design even better ones. So the machines and the tools available today help us design much better computers than [we could] as little as five years ago. And that is a fundamental change.

Also, the engineers are just able to get these things *out*. Obviously, things are not going to get simpler as we go faster. [The engineers] might have to do some very elaborate multilevel caches and some other things that need to be simulated very, very well, but the tools are just so much better now than ever before.

[One such tool] actually simulates the electromagnetic wave of each trace on the PC board before you have a built PC board, and it tells you, like, if you have a reflection problem before you ever lay out the board. That was unheard of just a few years ago. That [sort of thing] just helps us to design faster machines more efficiently.

Editor's note:
See biography, page 228.

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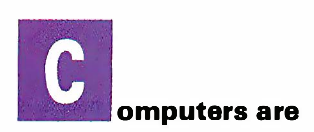


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What is going to be necessary to develop the new worldwide markets?



Computers are utterly subversive of dictatorships, because they're such a powerful instrument of communication.

—Brit Hume

Jerry Pournelle: Freedom in the world. That's an easy one.

Stewart Alsop: I don't think there should be a world market for computers, because computers are only valuable in the context of the society and culture that they're being used in. I think what we'll end up with is three basic computer markets in the world. We'll have a North American market, and a European market, and the Asian market.

John Markoff: My view of the next decade is [that] America will increasingly become a design center, and manufacturing will increasingly move to being close to the markets that it serves. So, in that sense, it will be a very global economy. I don't think the high-technology industry is any closer to that than anything else.

Gordon Campbell: I think as a nation we need to get much better at international selling and working as an international economic force. And that's something we haven't done as well as we should.

Rich Malloy: Free trade is probably a more global way of looking at it. And when you open things up and you have a free market, I think you have a lot of activity and a lot of things going on, and it's very exciting. When you start to regulate it or overregulate it, things start to slow down and move to freer markets.

Jerry Pournelle: Well, you must understand, I think the American way of doing business isn't very American anymore. I think we have glued regulations on top of things to the point where it is silly. I think the FCC is the worst enemy of American productivity I know of in the computer business. Let me elaborate on that for a minute. In order to market a new computer, you have got to essentially pay tribute to the FCC of $20,000 to $30,000. That means you have to get into the hands of the "vulture" capitalists in order to get your company going nowadays.

Paul Carroll: The spread of computerization outside the U.S. will have a significant effect. It's obviously already happened to a large extent in Europe and at least Japan. But I think that what goes on in Eastern Europe over the next few years will be important, and I think it will also be important to see what happens in parts of Southeast Asia. I think it's naive to think that this will all happen quickly. All you have to do is take a look at how long it's taken the Europeans to get as far as they have in terms of unity to see how slow the process will be.

Ken Sakamura: If Japanese PCs continue the way they are now, I'd say they probably won't be any more or less successful than now. But let me stress that this is if Japanese PCs continue like they are now, i.e., [based on] MS-DOS or whatever the future operating system is. I don't think we'll ever see the day that Japanese PCs sell as well as Japanese VCRs or TVs, at least not in America. The problem with Japanese PCs is really software. It's the lack of innovative software that's holding us back.

Charles Simonyi: I think the tremendous opportunity is that Europe is a tremendous growth area, in terms of market but also in terms of production. Certainly, we are recognizing how quite a bit of our revenue comes from international business, and a large percentage of that is Europe. But the opportunity for producing software in Europe has not been exploited yet.

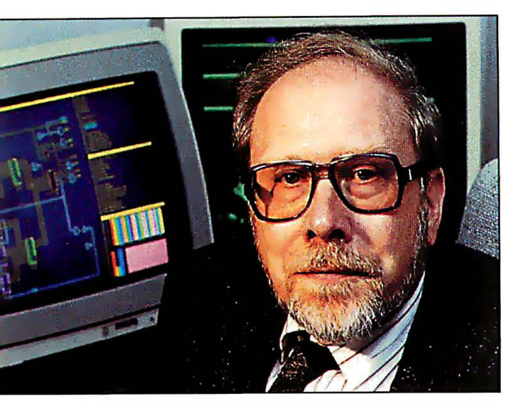
Gordon Campbell: Another strength that the U.S. has that we have to capitalize on is that the fundamental business language in the world is now English. That appears to be the common bridge throughout almost all of Asia. Even as we start exploring business opportunities in the U.S.S.R. and the Eastern bloc, English is again becoming the common way to communicate. So I think some of these fundamental things we really have to take advantage of if we're going to be successful.

Stewart Alsop: But there are two things that are important. One is that in an area like Eastern Europe, the problem has absolutely nothing to do with technology. The only problem they have is, they have no money. And if there's no money, there's no way to finance the development of computer technology. When it comes to where political changes are happening very rapidly, the fundamental problems are econom-

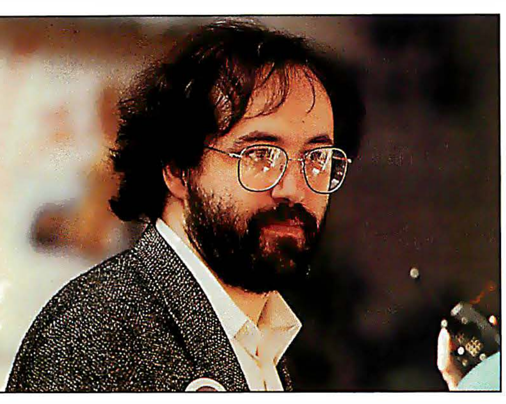
continued

ILLUSTRATION: CATHARINE BENNETT

Terry Winograd (not shown) is professor of computer science at *Stanford University* and is noted for his work in natural-language understanding in computers.



Niklaus Wirth is a professor at the *Swiss Federal Institute of Technology* (ETH). He is the designer of the Pascal and Modula-2 programming languages, the Lilith workstation, and the Oberon language and operating system. He is a recipient of the A. M. Turing Award.



Stephen Wolfram is founder and president of *Wolfram Research, Inc.*, which produces Mathematica. He has performed research into the behavior of complex systems at the Institute for Advanced Study at Princeton.



Edward Yourdon is an independent management consultant and author, and publisher of *American Programmer*, a journal that analyzes software technology trends. He is known as the developer of the "Yourdon method" of structured analysis and design.

ic and political, but not technical. And then the second thing is that while computing is fundamental and universal in that respect, it's also very cultural. I don't think it's possible [to] design one [computer] and sell it in multiple markets without changing it. And I think it would be a pipe dream for the industry to believe that the computer industry will be homogeneous around the world. Computers are this sort of multipurpose extension of the individual in that they have to reflect the cultural differences of individuals, of people living in different cultures and regions.

Rich Malloy: It's hard to gauge how much the events of the past year have been the result of electronic communication, but there must be some factor there. When you have information transferring so easily, it's hard to control populations. And so you'll probably see a tremendous move toward free societies who can pretty much try to rule themselves, as opposed to being ruled by a smaller society or an individual. And that's hard to stop; as Jerry Pournelle [says], you can't put the genie back in the bottle.

Brit Hume: My sense is that just about anything can go now. They're going to need the hardware. But once they get the hardware in their hands, I don't think there is much you can do but stand back and hope for the best. Anything you can do to encourage the ownership of microcomputers on the part of people in Czechoslovakia and Hungary and Poland and anywhere else is fine. Computers are utterly subversive of dictatorships, because they're such a powerful instrument of communication. My sense is that this will either take off on its own or it won't, and there's not a lot you can do to affect the outcome of that. The people there are either going to have the talent and the wherewithal to do it, or they're not.

Philippe Kahn: I think that those are very intelligent populations, very highly educated populations, who appreciate quality, etc., and are willing to do business on that level. I think that I see most U.S. companies doing business in the Eastern bloc in better and better ways.

Esther Dyson: I'm organizing a conference, the East-West High-Tech Forum (Budapest, [Hungary,] October 21–24, 1990), which will bring together people in computers from the East and the West. I'm meeting personally with every participant in the conference. I want to bring businesspeople and small entrepreneurs from Eastern Europe together with people in the computer business in the West.

The fundamental problems are economic and political, but not technical.

—Stewart Alsop

BYTE: ***Do you think we will ever see a "global village" network?***

Brit Hume: Of course. To some extent we already do [have a global village network]. Some of what came out of China during the Tiananmen Square protest was coming out by modem, some of it by fax machine. So there is some of that happening already. I don't know what else it would take, but my sense is that it's almost here.

Jerry Pournelle: You already have [a global village network]. Getting closer. Ain't going to be that long. You know the Chinese don't quite know how to shut down the fax system even now. Arthur Koestler in 1946 said that the necessary and sufficient condition for the end of totalitarianism is the free exchange of ideas. Well, you can't operate without it.

Dick Shaffer: If we see a global village, I hope I own vacation spots in [places] in which people can get cut off from that! Then what will be valued will be isolation.

Paul Carroll: Even if we did all get to the point where we were hooked up electronically, there would still be so many language differences and cultural differences that I don't expect to see anything approaching a global village in my lifetime.

Dick Shaffer: The only thing we know about the future is that predictions about it are almost always wrong. Not only in degree but often terribly wrong in direction, so, what I say, take it accordingly. I don't think a global village will occur, except to the extent that we can see via satellite real-

time photographs of what's going on in Vietnam. We know about assassinations in Israel the next morning—and to that extent, we're already a global village.

John Markoff: I think we will never see a global village in the McLuhan sense. McLuhan's view of the global village was very homogeneous, and I think one thing the computer networks are doing that McLuhan didn't foresee falls out of the nature of computer technology. Computers permit people to communicate in a many-to-many fashion, while television as a technology was essentially a one-to-many broadcast. And as a result, what the computers are going to do is create tiny separate villages focused on particular, very narrow passions that individual groups might have.

BYTE: ***Is there anything else you would like to say regarding computing in the future?***

Federico Faggin: The next 15 years are probably going to be even more exciting [than the last], in terms of technology and application of technology, and even more. We will not be able to anticipate many of the things that we will be able to do. And if we look back at the last 15 years where we have had enormous surprises, and enormous impact of technology, well, we have not seen anything yet. And neural networks will play a role. Neural will definitely play a role in this scenario.

Tom McWilliams: I guess the only thing I'd like to say is that, in the next 10 years, we're likely to see changes that are every bit as large as what we've seen in the last 10. And I think that advancement of computing on the chip will allow us to drive much better user interfaces, which will enable you to make much wider use of computers than what we've been able to do in the past with the relatively primitive user interfaces.

Rod Canion: You've really hit the high points with your questions. The key about it is, we're not at some plateau or some pinnacle. We're just really on the increasing slope of what the importance and the impact of microcomputers is going to be in the coming decade. It's an exciting place to be. All of us in the industry recognize how lucky we are to be here, and [we] feel good about what we're going to contribute to society and to the world. Then, after about a minute of that, [it's time to] roll up our sleeves and get to work. There's a lot to be done. ■

1975–1990

15 Years of Bits, Bytes, and Other Great Moments

Witness to the birth of the microcomputer, its infancy, childhood, and adolescence, BYTE continues to press forward on behalf of its readers

Gene Smarte and Andrew Reinhardt

The founders of BYTE were clever enough—or lucky enough—to start their new magazine the same year the microcomputer revolution ignited. Since 1975, BYTE's history has paralleled that of the industry, reflecting its booms and busts, its hype and hubris, and, above all, its intoxicating energy.

Before 1975, the drumbeats of change in the computer world were heard but not understood. Intel had introduced the first microprocessor, the 4004, in 1971, followed in 1972 by the 8-bit 8008 and in 1973 by the 8080. Nolan Bushnell of Atari revolutionized arcade games and later home entertainment with the Pong game in 1972, and that same year a group of Californians dedicated to demystifying computers formed the People's Computer Company. In 1973, Scelbi Computer Consulting created what was arguably the first microcomputer, the 8008-based Scelbi 8-H.

But it was in 1975 that things really took off. MITS introduced the Altair 8800, computer clubs started springing up all over the U.S., and three chips that would dominate the early years of the industry—the Zilog Z80, the MOS Technology 6502, and the Motorola 6800—were all introduced. By 1976, dozens of companies had joined the fray, the first microcomputer conferences were held, and the Apple II was just around the corner.

In the following pages, we replay the story of the microcomputer industry, with a history of BYTE woven in. Compressing 15 years into 30 pages sharpens our hindsight; some products that made hardly a ripple at their introduction have gone on to become giants, while other stars have sunk out of sight. Most of all, it's sobering to realize that despite the fantastic rate of growth and change in the computer industry, we are still dealing with many of the very same problems today that we faced five and even 10 years ago.

To provide a little perspective, we've also tossed in real-world events. As a reminder of how young this industry is, recall that the IBM PC hadn't even been announced when Ronald Reagan was inaugurated and that the Macintosh was introduced the same year that Michael Jackson topped the charts with *Thriller*. Perhaps we have all, at times, gotten caught up in compiler speeds or register definitions and lost sight of the big picture.

In its early days, the microcomputer industry careened recklessly forward, often heedless of issues in the wider world. But now, computers increasingly shape the direction of our world, and as their role grows in importance, we must address important questions about their social, political, economic, health, and environmental impact. Follow our journey through history and you will see once again just how quickly the microcomputer has developed from a curiosity into a necessity. ▷

Gene Smarte is BYTE's senior editor for special projects. He can be reached on BIX as "gsmarte." Andrew Reinhardt is an associate news editor for BYTE. He can be reached on BIX as "areinhardt."

RESEARCH: AMANDA WATERFIELD AND JEFF BERTOLUCCI

TIME LINE INDUSTRY PHOTOS, 1984-1990: PAUL AVIS

1975 Computer Industry



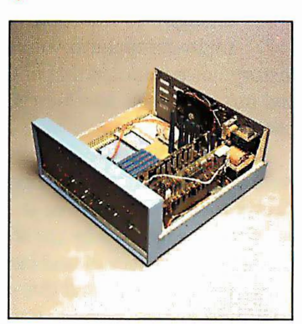
September
BYTE's first issue! The state of the microcomputer industry, if you can call it that, was reflected in the articles BYTE printed. "Recycling Used ICs" and "Deciphering Mystery Keyboards" clearly showed that this endeavor was meant for low-budget hobbyists. BYTE begins the practice of reviewing computers by looking objectively at the RGS 008A microcomputer kit, and Don Lancaster had an article on the "Serial Interface." As far as software was concerned, "Write Your Own Assembler" sort of says it all. Interestingly, this technically based type of article, appearing in the very first issue, was to become BYTE's hallmark.

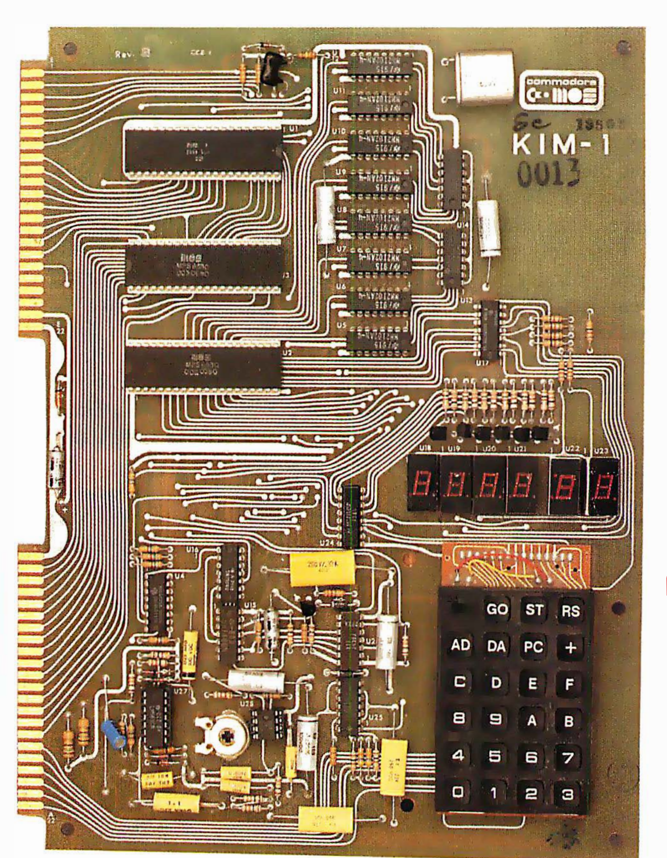
October–December
The first Robert Tinney cover illustration. Over the years and continuing today, Robert makes insightful contributions to BYTE. Hardware projects dominated because there were few commercial products available and enthusiasts could hardly afford them, anyway. "Assembling an Altair 8800" and "Build A 6800 System With This Kit" demonstrated that a few manufacturers were trying to fill needs. "The Software Vacuum" demonstrated that today's cry regarding hardware outpacing software is nothing new.

The Altair 8800 was featured on the cover of *Popular Electronics* as the "World's First Minicomputer Kit to Rival Commercial Models." Considered the first real microcomputer, it had an Intel 8080 processor, 256 bytes of memory, and a toggle-switch-and-LED front panel. The Altair sold for $395 (or $498 fully assembled), but up to $2000 worth of peripherals were needed to make it go. MITS shipped about 2000 of the machines in 1975. Pictured below right is the interior. ▷



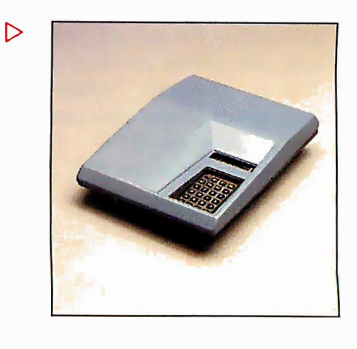
▽





◁ **MOS Technology announces the KIM-1, a $245 assembled single-board computer based on the 6502, with 1K bytes of RAM, LED readout, cassette and serial interfaces, and a 2K-byte ROM monitor. BYTE's write-up says that the KIM-1 "will prove attractive to readers who are not inclined to fondle hardware extensively."**

▷



WORLD

Zilog announces the **Z80** microprocessor, which will become the heart of the first major generation of non-Apple personal computers, the CP/M machines. It is available in February 1976.

The Homebrew Computer Club is founded by Fred Moore in Gordon French's Menlo Park garage.

Scelbi Computer Consulting announces the **Scelbi 8-B**, a successor to the 8-H. Both were based on the Intel 8008; the 8-B boosted memory capacity from 4K to 16K bytes and offered tape cassette and teletype interfaces, an oscilloscope-type CRT, and a ROM-based editor, monitor, and assembler.

The Amateur Computer Group of New Jersey is founded.

IMS International announces the **IMSAI 8080**, an improved clone of the Altair 8800.

MOS Technology announces the **6501** and **6502** microprocessors, which cost only $20 and $25, respectively, versus $150 for an Intel 8080. The 6502 will later become the heart of the Apple II line.

First issue of BYTE is published by Wayne Green and Carl Helmers.

Objective Design announces **Encounter**, the first microcomputer game, which is shipped in assembly language on paper tape.

Wavemate founded; introduces **Jupiter II** kit.

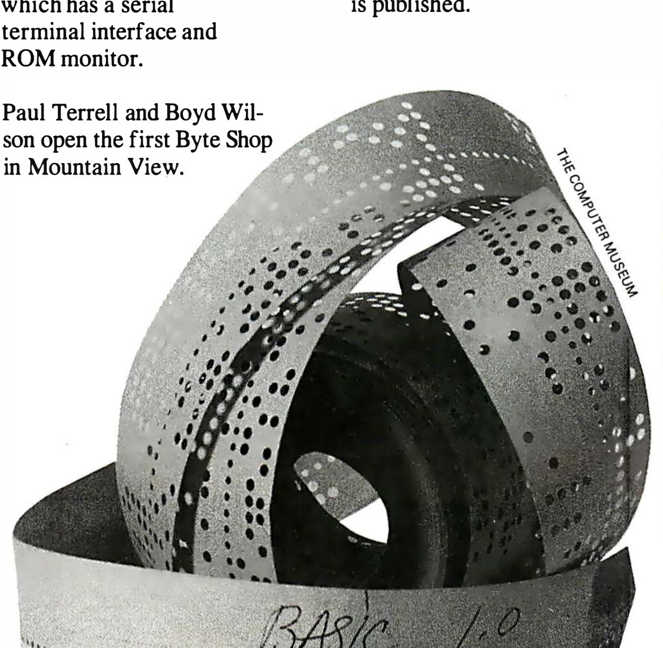
Southwest Technical Products introduces the $450 **M6800** computer kit, which has a serial terminal interface and ROM monitor.

Paul Terrell and Boyd Wilson open the first Byte Shop in Mountain View.

Microcomputer Associates offers the **JOLT** kit (6502, 512 bytes of RAM, serial interface to terminal, and monitor in ROM) for $249.

IBM announces the **IBM 5100**, a 50-pound briefcase-size computer with 16K bytes of RAM, BASIC, a 16-line by 64-character built-in display, and a magnetic tape storage system, for about $9000.

Ted Nelson's *Computer Lib* is published.



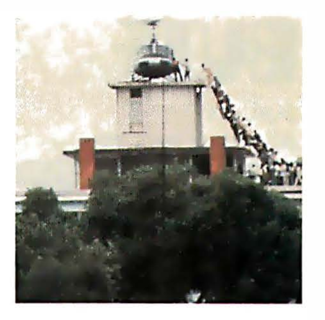


Bill Gates and Paul Allen write the first microcomputer BASIC and found Microsoft.

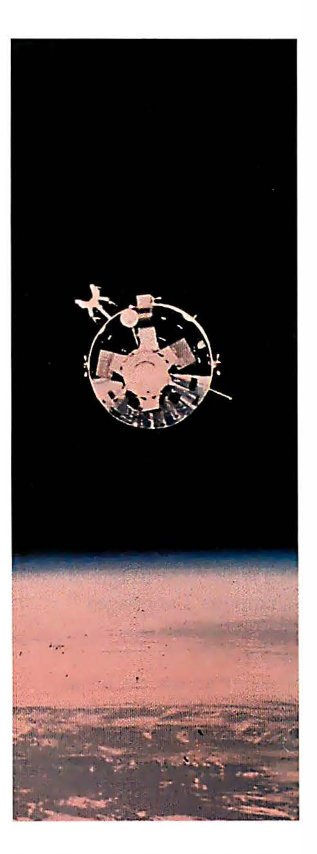
MITS announces its 4K- and 8K-byte BASIC, developed by Gates and Allen.



The Sphere I used a Motorola 6800 and offered 4K bytes of RAM, a keyboard, video interface, and ROM-based monitoring, all for $650.



Saigon falls.



The last Apollo mission is a joint flight with Soviet cosmonauts; spacecrafts link and crews share meals and a press conference.



The Concorde supersonic transport begins commercial flights.

1976 COMPUTER INDUSTRY

BYTE

JANUARY
All sorts of computer-related gizmos and interfaces for the home and other hobbies were appearing, along with games.

FEBRUARY
Memory was a worry then as now, as evidenced by "How to Save the Bytes." And as microcomputers began to find their way into more and more hands, one of the early scare-scenarios of the computer's proliferation moved from giant climate-controlled data-processing centers to desktops: "Could a Computer Take Over?"

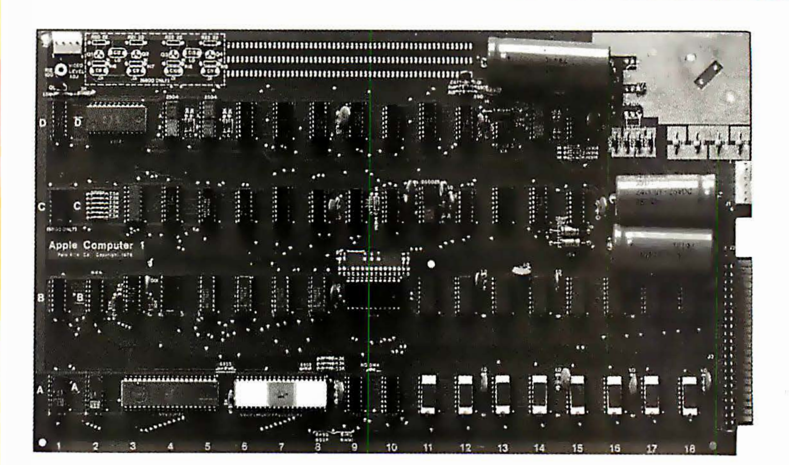
APRIL
More home control and other "We've got a computer, now what are we going to do with it?" articles. Don Lancaster writes "How to Build a Memory with One Layer Printed Circuits." And now things are starting to get interesting with "The Magic of Computer Languages."

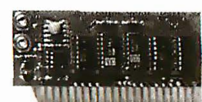
JULY
Despite advances, home-brewing was still in fashion with recycling "Coincident Current Ferrite Core Memories," "Build a FAST Cassette Interface," and "Make Your Own Printed Circuits."

AUGUST–DECEMBER
"What Do You Do With a Video Disk?" is a question that's finally getting answered today. Computers with voices were croaking in "The Time Has Come to Talk," and we looked at chips in "Microprocessor Update: Zilog Z80." Interest in computer games continued to grow. Steve Ciarcia first appears with "Make your Next Peripheral a Real Eye Opener" as part of a graphics focus in the November issue.

The 6502-based Apple I was a real bare bones computer: no case, power supply, or peripherals. But Steve Jobs (right) and Steve Wozniak (left) took one to The Byte Shop, which ordered a few dozen on the condition that the kit be preassembled. Thus was born Apple Computer.


APPLE COMPUTER, INC.

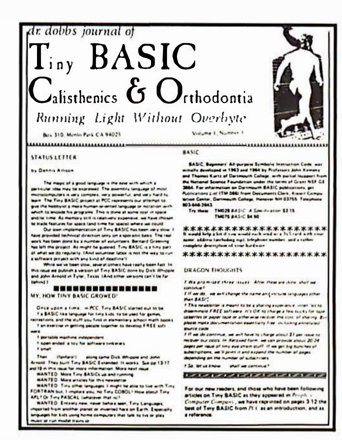






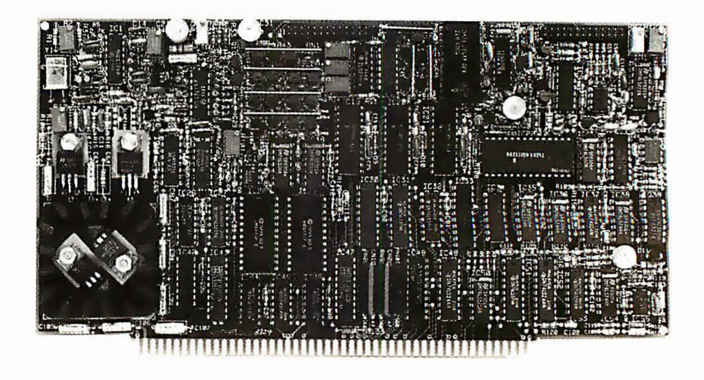


Processor Technology introduces the Sol, designed by Lee Felsenstein, a $995 kit with walnut sides and a metal case.


dr. dobbs journal of
Tiny BASIC
Calisthenics & Orthodontia
Running Light Without Overbyte

***Dr. Dobb's Journal of Computer Calisthenics and Orthodontia: Running Light Without Overbyte* publishes its first issue.**

The Cromemco TV Dazzler offered 128- by 128-pixel resolution, required 512 bytes of memory, and cost $215.



First microcomputer conference: David Bunnell of MITS organizes the World Altair Computer Convention at the Airport Marina Hotel in Albuquerque, New Mexico; 700 enthusiasts attend. Among the products introduced: the **Cromemco TV Dazzler**, the first microcomputer color graphics board.

Texas Instruments announces the **TMS9000**, the first 16-bit microprocessor.

Apple Computer is formed.

Steve Jobs and Steve Wozniak show the **Apple I** computer to the Homebrew Computer Club.

The first computer trade show of national scope: the Personal Computing Festival held in the Shelbourne Hotel in Atlantic City; Jobs demos the Apple, and the S-100 bus used in the Altair and IMSAI acquires its name.

Steve Wozniak proposes to Hewlett-Packard that it create a personal computer. Steve Jobs proposes the same to Atari. Both are rejected.

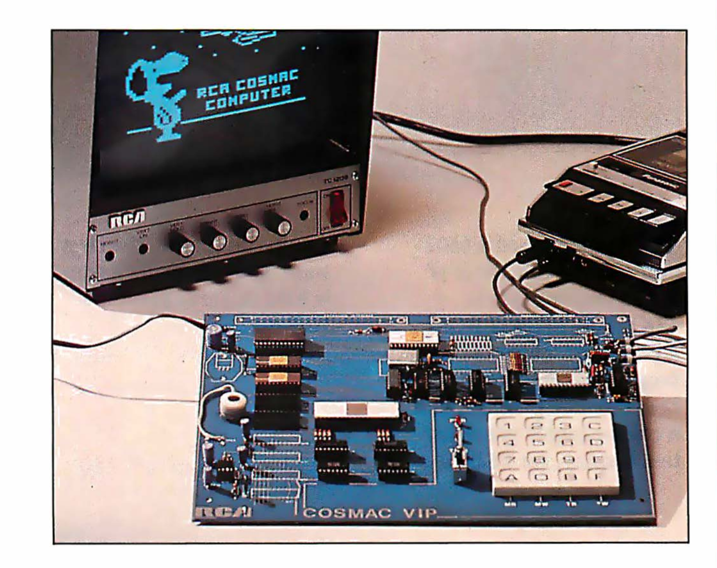
PolyMorphic Systems advertises the **Poly 88**, an 8080 machine based on the S-100 bus with 512 bytes of RAM, interfaces for video, keyboard, and cassette, and 1K bytes of ROM for $685 in kit form.

Michael Shrayer writes **Electric Pencil**, the first word processor for microcomputers.

Crowther and Wood develop the first **Adventure** game for microcomputers.

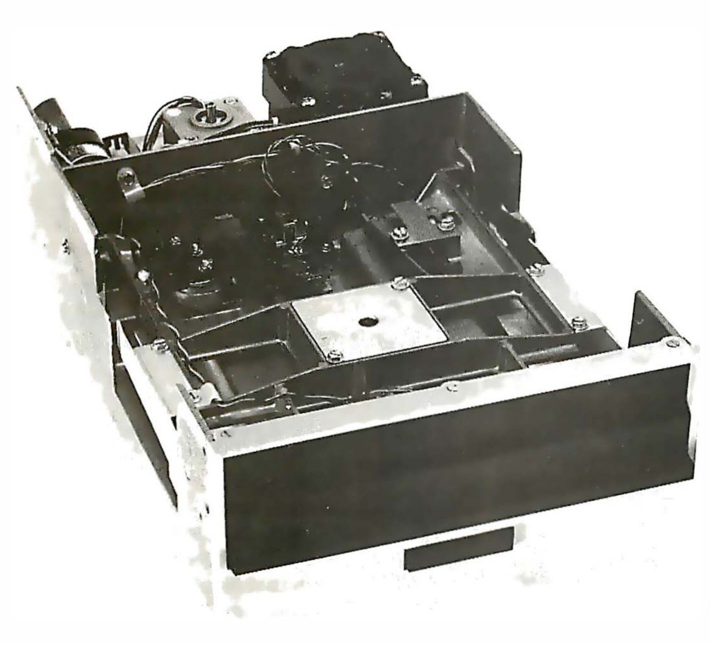
Cromemco introduces **Z-1**, the first Z80-based system, with 8K bytes of RAM and serial I/O for $2495.

At the urging of *Creative Computing* editor David Ahl, the NCC show for the first time devotes a day of conference sessions to microcomputers.





△ **RCA introduces the 1802 microprocessor. It is later used in the RCA COSMAC VIP system, which was developed by Joseph Weisbecker from a design he pioneered five years before called FRED. The COSMAC included 2K bytes of RAM, 512 bytes of ROM, a hexadecimal keypad, and interfaces for video, cassette, and audio. RCA later exited the computer business.**



◁ **Shugart announces its 5¼-inch "minifloppy" disk drive for $390.**



Viking I (July 20) and Viking II (Sept. 3) land on Mars and send back striking photographs of a barren, rocky landscape.

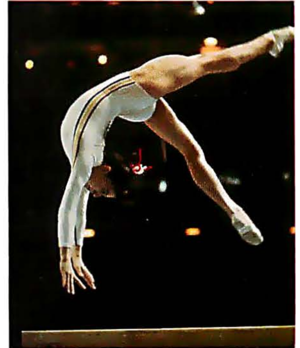
Chao-En Lai dies in China at 78.

Mao Tse-tung, the father of the Chinese revolution, dies at 82.

Israeli commandos rescue 104 hostages held captive at the Entebbe airport by Ugandan dictator Idi Amin.

The King Tut exhibit, first of the blockbuster art shows, opens in Washington, D.C.





Summer Olympics in Montreal: 14-year old Romanian pixie Nadia Comaneci wins five perfect 10s in gymnastics.

WORLD PHOTOS: UPI/BETTMANN

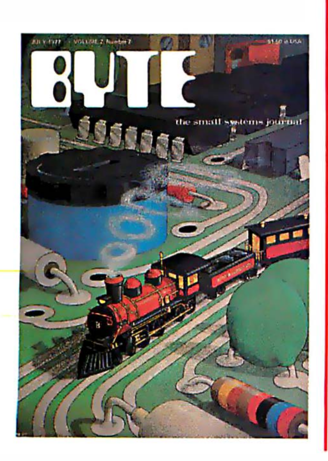
1977 COMPUTER INDUSTRY

BYTE

JANUARY–FEBRUARY
"Build the 'Coffee Can Special' EROM Eraser" and "Build This Economy Floppy Disk Interface" say it all. "Tiny" was operative with "A Review of Tom Pitman's Tiny BASIC."

MAY
Steve Wozniak provides a description of "The Apple II," introduced, along with the Commodore PET, at the first West Coast Computer Faire in April.

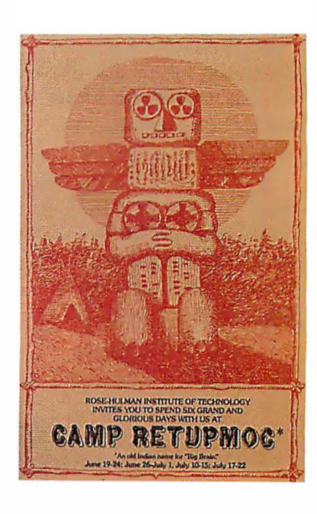
JULY–DECEMBER
Microcomputers were still looking for jobs in "How to Computerize Your Model Railroad." "Speech Recognition for a Personal Computer System" showed that this area was under exploration. Also, "SCORTOS: Implementation of a Music Language" and "Techniques for Computer Performances of Music" reflected this growing field. Although BASIC and assembly language dominated, "C: A language for Microprocessors?" hinted at things to come. Games such as Othello, Mastermind, NIM, and others appeared. Homebrewing continued to be a focal point in BYTE with the introduction of Ciarcia's Circuit Cellar.

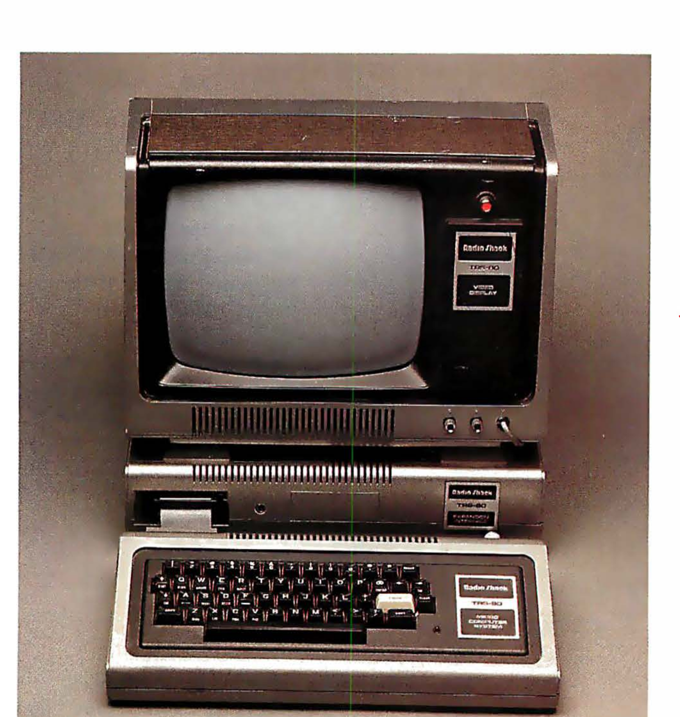




△ **The Apple II used a 6502 and offered 16K bytes of RAM (expandable to 48K), 16K bytes of ROM, a keyboard, cassette interface, eight-slot motherboard, game paddles, and a color-capable graphics/text display, for $1298.**

Camp Retupmoc, the first week-long computer camp, is held in Terre Haute, Indiana. ▷





◁ **The TRS-80 (TRS stood for Tandy Radio Shack) used a Z80 and had 4K bytes of RAM and 4K bytes of ROM (including BASIC), a keyboard, display, and cassette interface. Tandy spent only $150,000 to develop the system, including design, tooling, and software. Reportedly, only a few thousand were made so that if it flopped, the systems could be used to track inventory in Radio Shack stores.**

Ohio Scientific Instruments offers the first microcomputer with Microsoft (floating-point) BASIC in ROM.

Computer Shack (later to become ComputerLand) opens its first franchise store in Morristown, New Jersey.

Jim Warren organizes the first West Coast Computer Faire in San Francisco.

Apple introduces the **Apple II** at the WCCF.

Radio Shack introduces the $600 **TRS-80**.

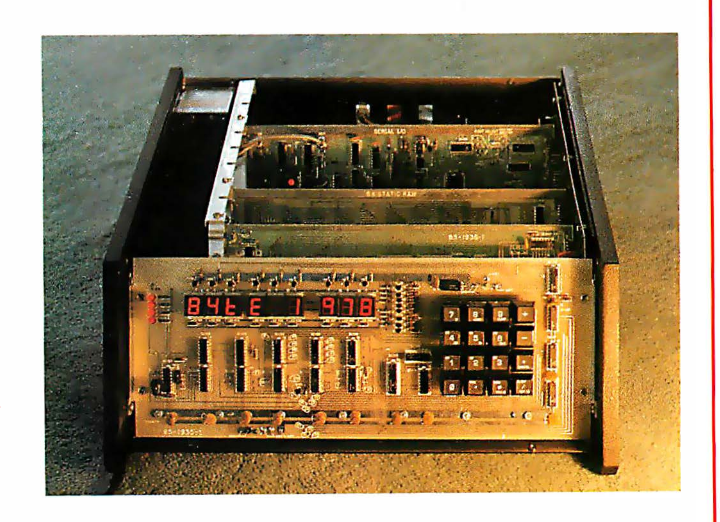
North Star Computers announces the **Horizon** (Z80, 16K bytes of RAM, one 5¼-inch floppy disk drive, 12-slot S-100 bus, serial I/O) for $1999.

Micropolis introduces the **Metafloppy**, a 5¼-inch floppy disk drive with the capacity of 8-inch disks.

The venerable *Computerworld* adds a section on microcomputers.

Gary Kildall of Digital Research develops the **CP/M** (control program for microcomputers) operating system, which drives the first generation of PCs but will be passed up by IBM in favor of MS-DOS.

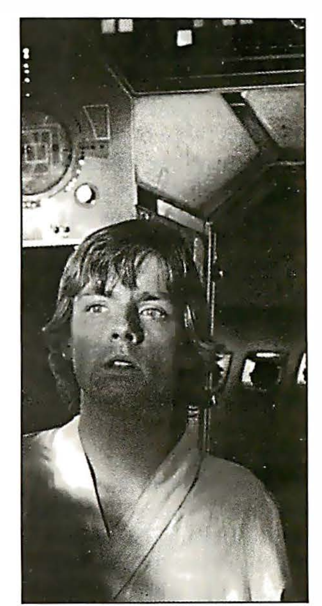
MITS is sold to Pertec Computer Corp.



Heathkit introduces the H-8 microcomputer kit based on an 8080 processor with an octal front-panel keypad. ▷



Commodore Business Machines unveils the Commodore PET (Personal Electronic Transactor) at the West Coast Computer Faire in April. The 6502-based machine cost $595 assembled and included 4K bytes of RAM, 14K bytes of ROM, keyboard, display, built-in cassette tape drive, and 8K Microsoft BASIC. ▷

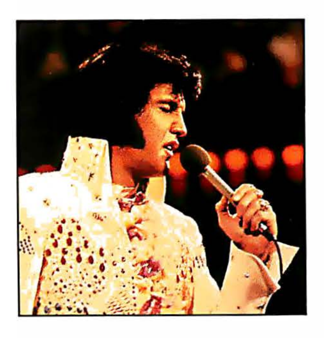


***Star Wars* blows away moviegoers and is the top-grossing film of the decade.**

The TV show *Roots* becomes the most-watched miniseries in TV history and spurs crazes for genealogy and miniseries.

Carter pardons Vietnam War draft evaders.

Worst aircraft disaster in world history: KLM and Pan AM 747s crash on a runway in Tenerife, the Canary Islands, killing 581 people.



Elvis Presley dies at Graceland.

Voyager 2 launched; it will encounter Jupiter, Saturn, Uranus, and Neptune on its way out of the solar system.

WORLD PHOTOS: UPI/BETTMANN

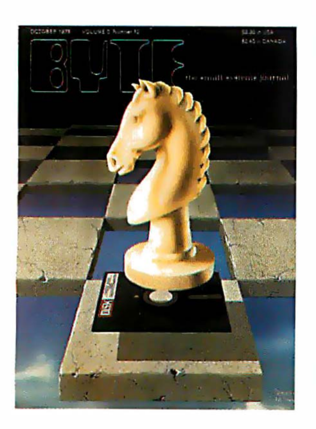
1978 COMPUTER INDUSTRY

BYTE

JANUARY–APRIL
The first "year of the LAN" may have appeared with "Personal Computers in a Communications Network." Robotics-related articles continued to appear. Microcomputer training begins to get serious with "A College Microcomputer Facility." The long-lived TRS-80 gets a review.

JUNE–JULY
Real-world applications continue to emerge: "A Theatrical Lighting Graphics Package" and "Audio Processing with a Microprocessor." Also, the fixed disk drive, an expensive glint in users' eyes, is described in "A Look at Shugart's New Fixed Disk Drive." And computer industry retrospection is nothing new: "A Short History of Computing" and "The First Ten Years of Amateur Computing" appeared in July.

AUGUST–DECEMBER
In August we focused on Pascal, the start of a long-lived tradition of BYTE's annual August language issue. Computerized chess programs proliferated. The "Hobbyist Computerized Bulletin Board" could only hint at what we have today. "FORTRAN and Its Generalizations" combined with Pascal, C, and BASIC, to develop a rich set of languages for the "hobbyist."



The Atari 400 (bottom) and 800 (top) were both based on the 6502. The 800, which cost $1000, had a full keyboard, 8K bytes of RAM (expandable to 48K), two ROM cartridge slots, and custom sound and graphics chips designed by Jay Miner (who later designed the Amiga's custom chips). The 400 had an unfortunate membrane keyboard. Neither machine shipped until late 1979.



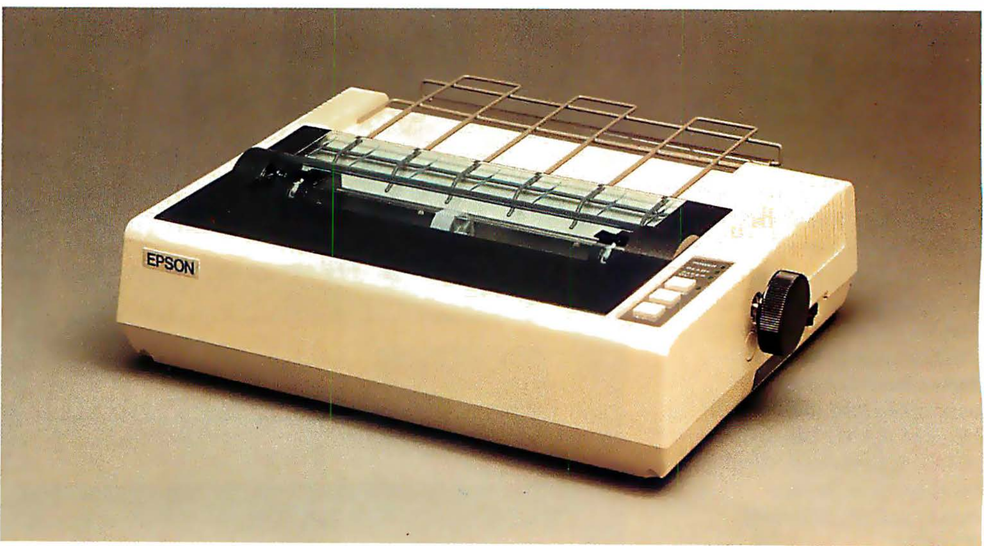




The Digital Group announces the Bytemaster, a sewing-machine-size computer housing a display, keyboard, and disk drive. Never very popular, it predates the Osborne 1.

Epson America introduces the MX-80 dot-matrix printer and revolutionizes the low-cost printer market.





MicroPro International, founded by Seymour Rubenstein of IMSAI, announces **WordMaster**, precursor to WordStar.

Dan Bricklin and Bob Frankston team up to develop **VisiCalc**.

Apple and Radio Shack announce 5¼-inch floppy disk drives.

Houston Instruments announces **HiPlot** plotter.

Summagraphics announces **Bit Pad**, the first digitizer.

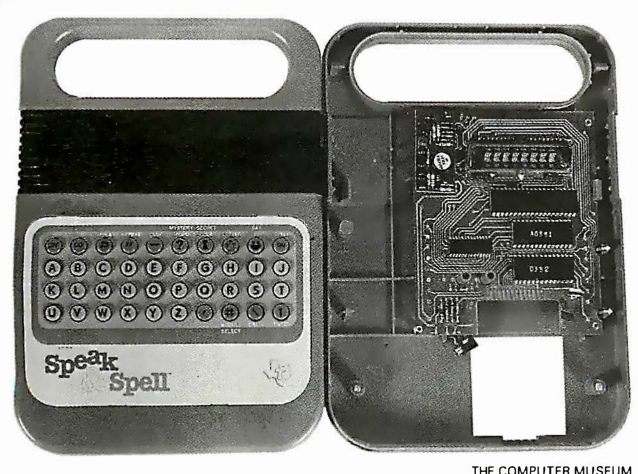
Computer Headware announces **WHATSIT** database manager.



The Exidy Sorcerer sold for $895 and included a Z80; 8K bytes of RAM; 12K bytes of ROM; a keyboard; and serial, parallel, and cassette interfaces. Its major innovations were the use of plug-in ROM cartridges for software and user-definable characters.

Texas Instruments introduces Speak and Spell, the first talking toy to use digital speech synthesis.





THE COMPUTER MUSEUM

WORLD



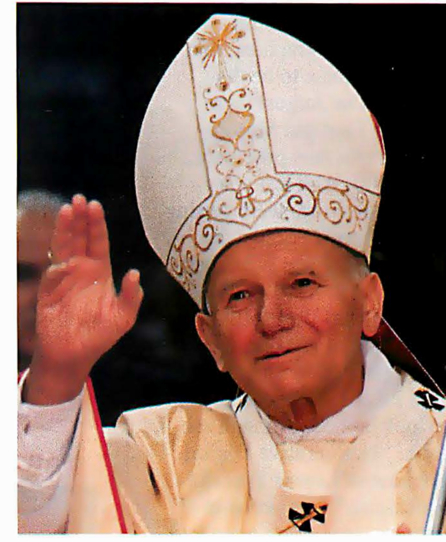
Camp David agreements bring together Israel and Egypt.

The Supreme Court's Bakke decision outlaws strict racial quotas for affirmative action.

Louise Brown, the first "test tube" baby, is born in England.

Catholics get a new pope, John Paul I, but he dies only 33 days later.

Polish cardinal John Paul II is elevated to the papacy.



California voters pass Proposition 13, an antiproperty tax initiative that kicks off a national tax revolt.

Sony introduces the Beta-format VCR and kicks off the home-video revolution; VHS arrives in 1979.



WORLD PHOTOS: UPI/BETTMANN

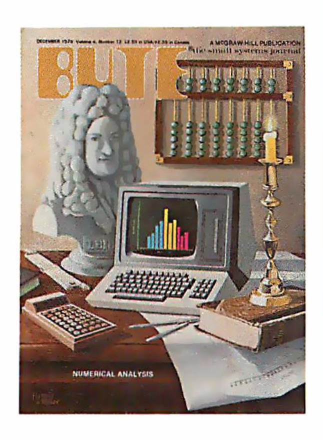
1979 COMPUTER INDUSTRY

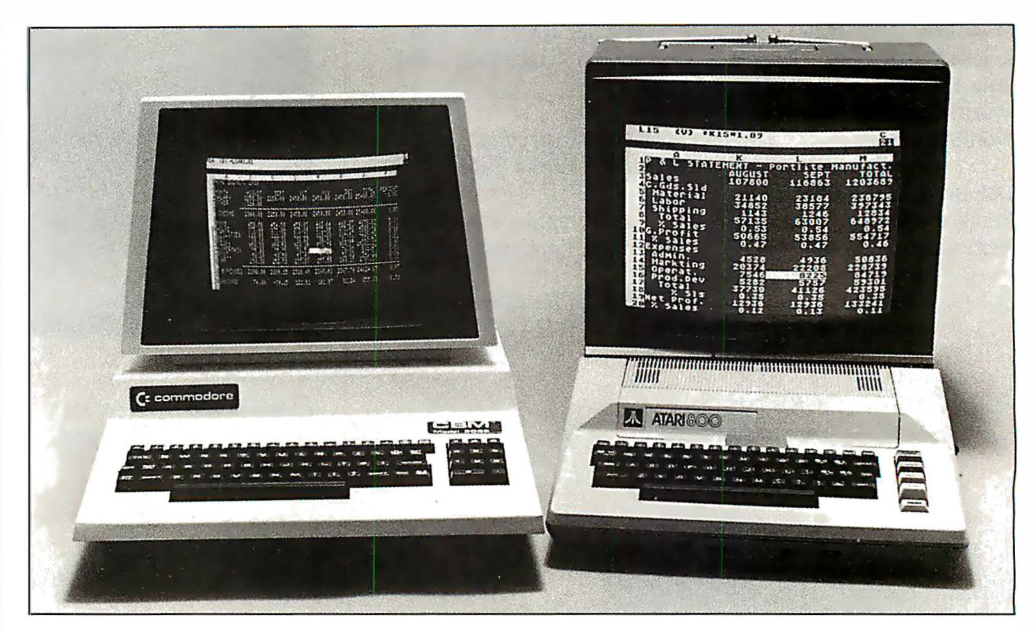
BYTE

JANUARY–MARCH
Today's deluge of junk mail might be traced back to "A Computerized Mailing List." More beneficial topics covered were MUMPS, IPS, and "Elements of Statistical Computation." Mac-ace-to-be Jef Raskin looked at "Unlimited Precision Division." Computer security was already an issue, as "The Standard Data Encryption Algorithm" shows.

JUNE–SEPTEMBER
Man keeps trying to figure out the human brain: "A Model of the Brain for Robot Control." Bubble memories burst on the scene. Math, graphics, and music continue to be discussed. The August issue looks at Lisp and Motorola's curious new processor, the 68000. And lest you think that things were getting sophisticated, "Soldering Techniques" was published.

NOVEMBER–DECEMBER
Steve Ciarcia looked at "The Intel 8086" system design kit. Applications began to look less odd, though esoteric: "Noniterative Digital Solution of Linear Transfer Functions." The problem of memory crunching appeared in an article on text compression using Huffman codes. Programming diversity was demonstrated in "Twenty-Four Ways to Write a Loop."





Dan Bricklin and Bob Frankston of Software Arts show VisiCalc at the WCCF. It is marketed by Personal Software, later to become VisiCorp.

Hayes Microcomputer Products announces the Micromodem 100 (bottom). This auto-dial, auto-answer modem transmitted at 110 to 300 bps and retailed for $399.



MICROMODEM 100: HAYES MICROCOMPUTER PRODUCTS, INC.

WORLD

CompuServe founded.

The Source founded.

Magic Wand becomes WordStar's first serious competitor.

Wayne Ratliff develops the **Vulcan** database program that will later become dBASE II.

Video games, such as Space Invaders and Pac Man, become a huge craze.

Intel introduces the **8088**, which will become the heart of the IBM PC.

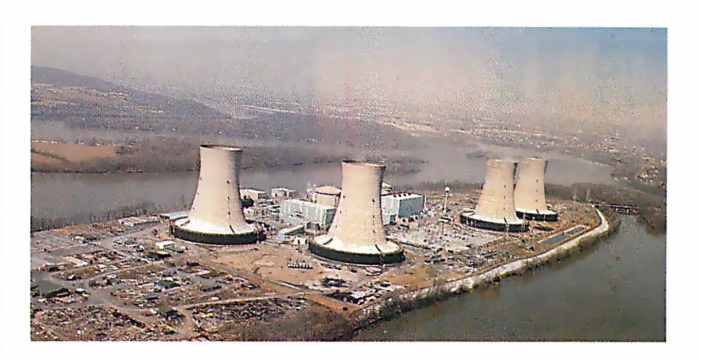
The first Apple clone appears at the West Coast Computer Faire; it is called, appropriately enough, the **Orange**.

Xerox, DEC, and Intel announce **Ethernet**.

The TI-99/4, which included a color monitor in its $1150 price, suffered from slow performance (despite being based on the 16-bit TMS9900 processor), an awkward keyboard, and a lack of third-party software support. The TI-99/4A was an improvement, but the firm took a huge loss on the machine and in the end units sold for as little as $99.







Three Mile Island disaster nearly melts down the U.S. nuclear industry.



Margaret Thatcher is elected the first female prime minister of Great Britain.

An American Airlines DC-10 crashes outside Chicago in the worst disaster in U.S. aviation history, killing all 275 aboard. The FAA grounds all DC-10s.

Sony introduces the Walkman.

Sandanistas come to power in Nicaragua.

Skylab, launched in 1973, falls out of orbit over Australia, leaving a fiery trail of debris.

The U.S. government bails out Chrysler in a $1.5 billion deal.

Star Trek: The Motion Picture is the first of a successful film series.

The Soviet Union invades Afghanistan, starting the war that will become its "Vietnam."

Annual U.S. energy consumption peaks at 78.9 quadrillion BTUs.

Ninety hostages, including 63 Americans, are seized in Iran by militant student followers of the Ayatollah Khomeini.



WORLD PHOTOS: UPI/BETTMANN

1980 COMPUTER INDUSTRY

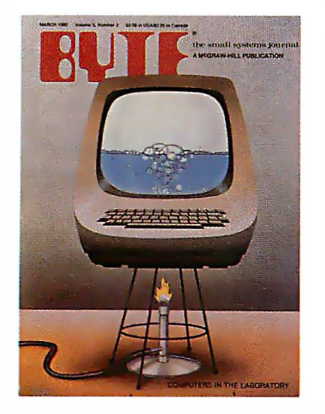
BYTE

JANUARY–MARCH
Two articles foretold some things to come: "Telephone Dialing by Computer" and "A Computer-Generated Reminder Message," called Tickler. Scientific applications were emerging with programs that solved the Schrödinger wave equation and modeled hydrocarbon molecular bonding on an Apple II.

JULY
The beginnings of VDI might be traced to "Interactive Control of a Videocassette Recorder with a Personal Computer," which linked a Sony Betamax with an Apple II or TRS-80. Several articles made up an "Education Forum." And, significantly, "science fiction writer" Jerry Pournelle began one of the longest-running and most widely read computer magazine columns.

SEPTEMBER
Personal computing gets down to business with "A Basic Floppy-Disk Accounting System," a "six-program package to keep your budget records in order." BYTE turns five years old.

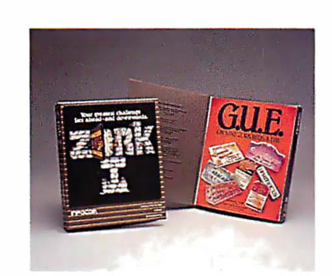
NOVEMBER
Digital imaging and visualization are big topics today. Back in 1980, they were just emerging with "Digital Storage of Images."







◁ **The Sinclair Research ZX80 was the first microcomputer to cost less than $200. Based on a Z80 with 1K bytes of RAM and 4K bytes of integer BASIC in ROM, it had a membrane keyboard and was the brainchild of English genius Clive Sinclair. The successor ZX81 (inset) was later sold by Timex and dropped to less than $100 before Timex exited the market.** ▽



◁ **Personal Software introduces Zork, the Underground Empire, a "second-generation" computer adventure game.**

The Commodore VIC-20 was targeted at the same buyer as the TI-99/4, but it was a better machine. It used a 6502A and offered 5K bytes of RAM, BASIC in ROM, serial, cassette, and modem interfaces, a color display, and ROM software cartridges, for $299. It became the first million-seller in the history of the industry. ▽



World

The first issue of *Infoworld* is published.

Apple announces the problem-plagued **Apple III** for $3495.

Shugart begins selling 5¼-inch **Winchester** drives that hold 80 times as much data as a standard floppy and transfer data 20 times faster.

Radio Shack announces the **TRS-80 Color Computer**.

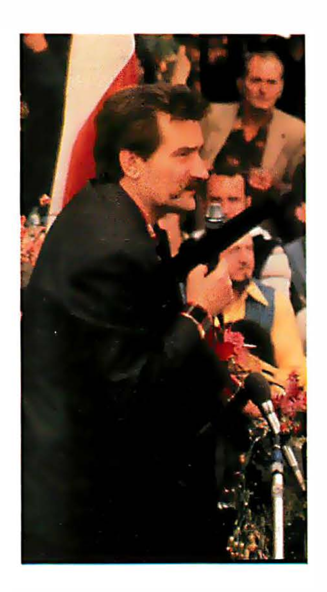
Altos introduces the first microprocessor-based multiuser system; the **8000-5** used a Z80A, supported up to four people, and sold for roughly $8500.

Apple goes public with 4.6 million shares sold at $22 apiece; Jobs and Wozniak are instant multimillionaires.

Digital Research announces **CP/M-86**.

Satellite Software International, later WordPerfect Corp., announces the first version of **WordPerfect** for Data General computers.

Apple's successor to the hugely successful Apple II was a business computer called the Apple III that was a disaster. Shipped a year late, the machine initially suffered a nearly 100 percent failure rate and almost dragged down the company.



Polish Solidarity trade union forms; it will pave the way for reform in Eastern Europe nine years later.

Ted Turner's CNN begins broadcasting and changes the face of TV news.

Ronald Reagan wins the presidency.

Fire sweeps through MGM Grand Hotel in Las Vegas during the second Comdex show, killing 84 people.



Mount St. Helens blows up, killing at least 25 people and casting ash across the northwestern U.S.

The U.S. hockey team wins the gold at Lake Placid.

WORLD PHOTOS: UPI/BETTMANN

1981 COMPUTER INDUSTRY

BYTE

MAY
BYTE looked at "The Commodore VIC 20 Microcomputer: A Low-Cost, High-Performance Consumer Computer." Software piracy and protection issues were discussed."

JUNE
Gary Kildall explained Digital Research's operating systems, while Unix and Xenix were moving down from large-computer environments in other articles. Author Stephen Wozniak describes how "An 8-bit microcomputer is harnessed to the Herculean task of computing the mathematical constant *e* to 115,925 places."

AUGUST
Smalltalk isn't just small talk anymore. Adele Goldberg prefaces this very popular topic and BYTE issue.

SEPTEMBER
How to benchmark systems has been a popular topic for years. In "A High-Level Language Benchmark," the now-classic Sieve of Eratosthenes is introduced.

OCTOBER–DECEMBER
Later-to-be editor in chief Phil Lemmons provided a first impression of the IBM PC, noting that "The computer giant embraces software compatibility and support for independent peripheral manufacturers."





△ **Adam Osborne, publisher of microprocessor books, unveils the $1795 Osborne 1 Portable. It includes a Z80, a 5-inch display, 64K bytes of RAM, a keyboard and keypad, two serial interfaces, two 5¼-inch floppy disk drives and bundled software.**

The Alto, developed by researchers at Xerox PARC, paved the way for the Macintosh. Although never sold as a commercial product, the Alto came with the Smalltalk programming language, a mouse, and Ethernet connectivity. ▽



IBM introduces the PC, which costs $3005 for an 8088, 64K bytes of RAM, and a single 5¼-inch floppy disk drive. Its importance cannot be understated. ▽



Warner Amex, Atari, and CompuServe announce cable TV information service.

Steve Wozniak crashes his private plane but survives to return as an incognito grad student at Berkeley. He sponsors the money-losing US Festivals.

Tracy Kidder's *The Soul of a New Machine*, a chronicle of the development of a Data General minicomputer, becomes a national bestseller.

Timex contracts with Clive Sinclair to market the **Timex/ Sinclair 1000**, the first under-$100 computer in the U.S.

Atari and Mattel **Intellivision** video games are huge hits in an otherwise disappointing Christmas season for computer makers.

Corvus introduces **Omni-Net**, an inexpensive twisted-pair LAN.



△ **Epson America shows the HX-20, perhaps the first laptop computer; the machine weighs less than 3 pounds and uses a CMOS version of the 6801, 16K bytes of RAM, and a 20-character by 4-line display.**

Hayes introduces the Smartmodem 300, which becomes the industry standard. ▽



WORLD



First launch of the space shuttle, the Columbia.



Iranian hostages released minutes after Reagan inaugurated.

Assassination attempt on Ronald Reagan; the would-be killer is a loner fixated on actress Jodie Foster.

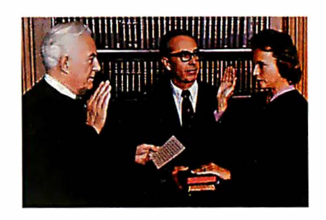
Assassination attempt on Pope John Paul II in St. Peter's Square, Rome, by escaped Turkish criminal Mehmet Ali Agca.

The as-yet-unidentified AIDS epidemic is first reported in the Center for Disease Control's Morbidity and Mortality Weekly Report.

Francois Mitterand becomes the first socialist president of France.

Anwar Sadat is murdered by Moslem extremists.

Martial law imposed in Poland by ruling Communist leaders.



Sandra Day O'Connor is confirmed as the first female Supreme Court Justice in U.S. history.



Charles and Di tie the knot.

WORLD PHOTOS: UPI/BETTMANN

1982 Computer Industry

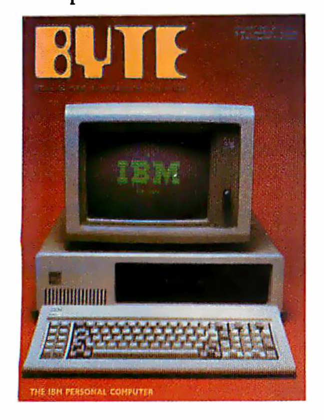
BYTE

JANUARY
Real-world applications continued to grow, and BYTE published "A Closer Look at the IBM Personal Computer." And for "under $200" you could add a whopping 16K bytes to your Sinclair ZX-80.

APRIL
BYTE looked at human factors in human/machine interfaces for both hardware and software, a topic of considerable interest today (and probably well into the future).

JUNE–AUGUST
Multimedia is a hot topic today, and BYTE provided state-of-the-art information on an emerging, accessible technology, the videodisk. More mainstream applications emerge. LOGO, a language designed to introduce kids to computers, gets some in-depth adult treatment in a comprehensive series of articles.

SEPTEMBER–DECEMBER
Steve Ciarcia begins his MPX-16 Computer System project, an IBM workalike. BYTE evaluates Epson's unique QX-10/Valdocs system, we have reports from the National Computer Conference and the Hanover Fair, and "A Comparison of Five Compilers for Apple BASIC" reinforces the BYTE tradition of providing in-depth technical material.





△ **Compaq Computer Corp. announces the Compaq Portable, an IBM PC–compatible system.**



◁ **Commodore announces the Commodore 64. Based on the 6510, it included 64K bytes of RAM, 20K bytes of ROM (including Microsoft BASIC), a custom sound chip, color graphics, and a serial interface. It retailed for $595, but eventually the price dropped to around $200.**

◁ **Kaypro (then called Non-Linear Systems) announces the $1795 Kaycomp II portable; with a 9-inch screen and bundled software, it was targeted to compete with the Osborne.**

GRiD Systems announces its first pricey executive portable, the futuristic-looking $8000 **Compass 101**.

Franklin Computer Corp. announces the **Ace 100**, an Apple II clone.

David Bunnell starts *PC Magazine*.

Lotus Development introduces **1-2-3** at Comdex.

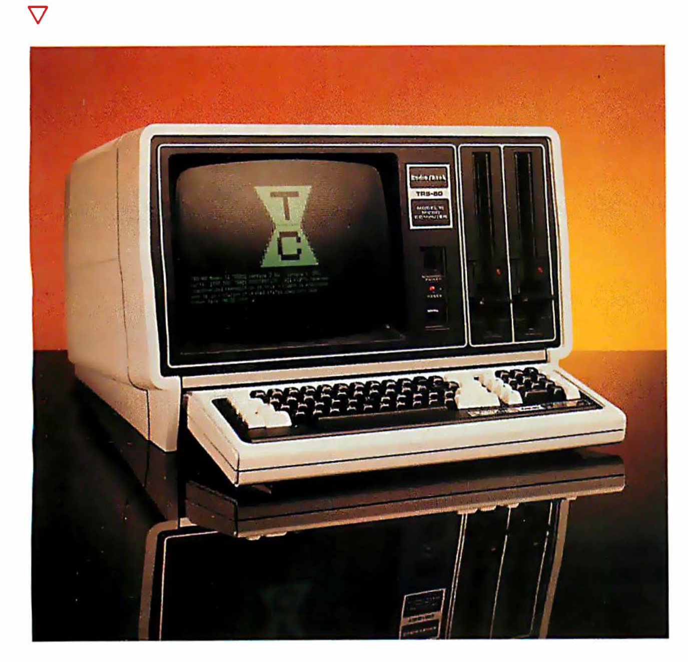
Intel announces the **286**.

Autodesk announces **AutoCAD**, the first CAD system for the PC.

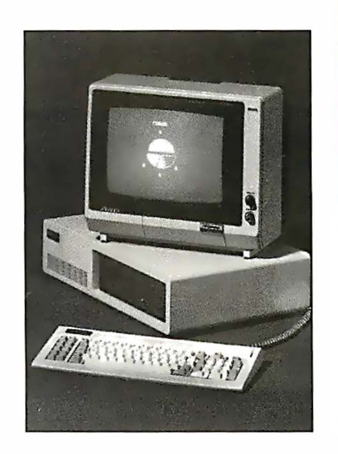
Peter Norton Computing introduces the **Norton Utilities**.

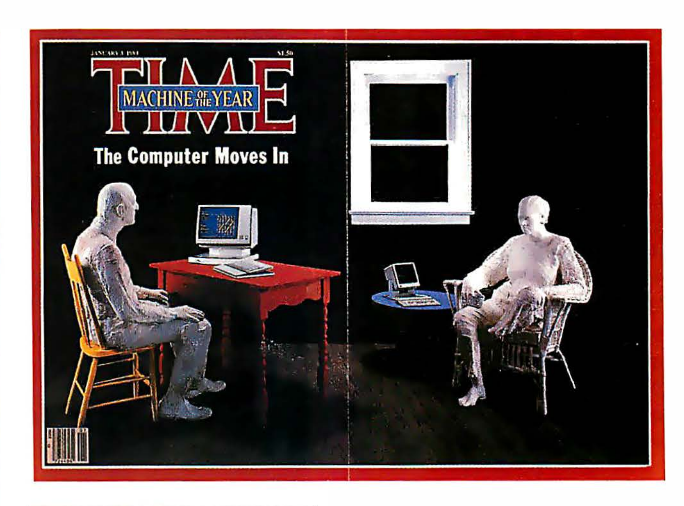
Softsel publishes its first Hot List, originally called the "Top 100."

Radio Shack announces the TRS-80 Model 16, based on a 68000 and Z80, with 128K bytes of RAM and an 8-inch floppy disk drive, for $4999. ▽

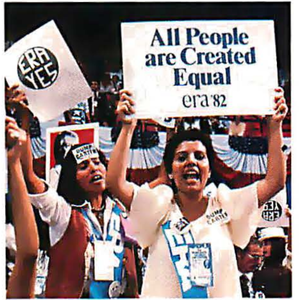


Columbia Data Products announces the first IBM PC clone, the MPC; it is soon joined by Compaq and Corona, but only Compaq thrives. ▷





***Time* magazine names the computer its annual Man of the Year.**

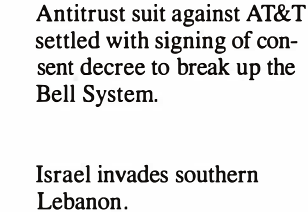


The Equal Rights Amendment is defeated after a 10-year struggle for passage.

Antitrust suit against AT&T settled with signing of consent decree to break up the Bell System.

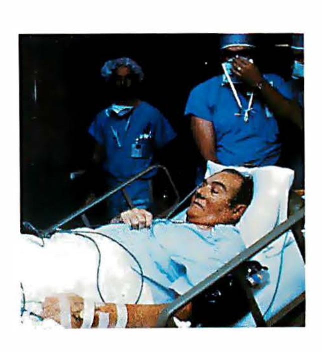
Israel invades southern Lebanon.

The movie *Tron* glorifies video games and includes an unprecedented computer animation sequence but is otherwise disappointing.





Falklands War: the QE2 is commandeered as a troop carrier; the British use the Harrier and the Argentineans use the Exocet.



Dr. Barney Clark receives implant of first artificial heart.



***E.T.* lands in theaters to become the most successful movie of all time.**

WORLD PHOTOS: UPI/BETTMANN

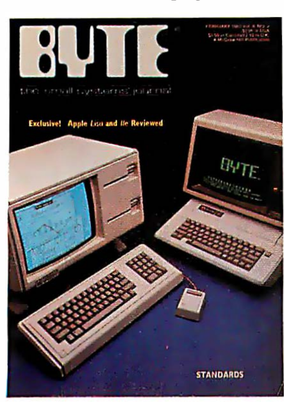
1983 COMPUTER INDUSTRY

BYTE

FEBRUARY–MARCH
Lisa arrives not quite dressed for the ball. BYTE discussed "A Proposed Floppy-Disk Format Standard," ANSI standard BASIC, NAPLPS, the IEEE S-100 bus standard, and graphics standards. Several articles, such as "The Promise of Perpendicular Magnetic Recording," played out new mass storage scenarios.

APRIL–MAY
A series begins on the 68000 chip, which will later proliferate in the Macintoshes. We looked at coprocessing with the 8087 chip, provided for in the original IBM PC by an empty socket. Niklaus Wirth's Modula-2 is introduced. The promise of the paperless office is as yet unfulfilled, although BYTE devoted its Theme to the topic in May.

AUGUST–NOVEMBER
In August, BYTE looked at the C language and a little of Unix, topics that often dominate conversations today. "Computing on the Run" looked at the developing portables and the technology behind them—rather primitive by current standards, yet intriguing and exciting then. Then, in October, Unix received closer scrutiny in its own Theme. And for November, the "Inside the IBM PC" Theme spearheaded BYTE's largest issue so far, 720 pages.





Apple unveils the Lisa, a $10,000 machine based on the 32-bit 68000 and featuring a graphical user interface and mouse.

Apple also announces the Apple IIe, priced at $1395.



Radio Shack announces the 4-pound TRS-80 Model 100 for $800.





Tandy announces the 80186-based Tandy 2000.

Coleco unveils the Adam at CES, but it becomes the "Adam bomb."



The Gavilan computer, a laptop with built-in software and a touchpad "mouse," is introduced at Comdex but never takes off.



WORLD

Novell introduces **NetWare**, the first file server LAN operating system.

Micro Edsels: Atari announces the **1200XL**, and Mattel announces the **Aquarius**.

IBM introduces the **XT**, which adds a 10-MB hard disk drive and three more slots to the original PC design, for $4995.

PC Magazine sold to new owners; most of staff quits to form *PC World*.

Microsoft announces **Word** (originally called Multi-Tool Word).

Microsoft and a group of Japanese companies announce the **MSX** standard for Z80-based computers.

Osborne files for Chapter 11 bankruptcy.

IBM announces the PCjr, which is arguably the company's biggest failure of the 1980s despite reengineering and huge marketing.







AST introduces the hugely successful **SixPakPlus**, a PC add-in combining memory expansion; serial, parallel, and game ports; clock/calendar; and utility software.

Shugart shows a 1-gigabyte WORM drive for $7600.

Borland International announces Turbo Pascal for CP/M and 8088 machines.

Ovation Technologies announces **Ovation**, perhaps the most hyped-up product to that point, and it never ships; the term *vaporware* is coined to describe it.

Compaq goes public, and 6 million shares are sold in one day.

Canon displays a 300-dpi laser printer engine for OEMs that costs less than $2000; it shows up the next year in the HP LaserJet.

Microrim, founded by Wayne Erickson in November 1981, introduces **R:Base 4000**, the first relational database for PCs.

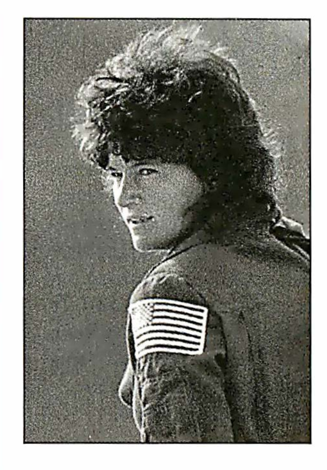
Microsoft announces **Windows**, but it doesn't ship for two years.

The Semiconductor Industry Association reports a book-to-bill ratio of 1.6, the highest ever recorded.

AT&T announces **Unix System V**.

Iomega introduces the first **Bernoulli Box**, an innovative removable disk drive.

◁ **The Hewlett-Packard HP 150 was an 8088-based machine that offered a unique touchscreen.**



Sally Ride becomes the first U.S. woman in space aboard the shuttle Challenger.

Faked Hitler diaries capture the news.

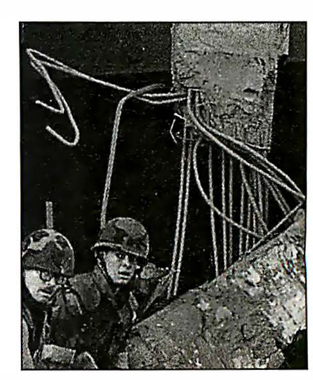
Dr. Luc Montagnier of the Pasteur Institute in Paris discovers the virus that causes AIDS.

Philippine opposition leader Benigno Aquino fatally shot while disembarking at Manilla Airport.

Soviets shoot down Korean Air 007, killing 269 people.

Lech Walesa wins Nobel Peace Prize.

U.S. Marine barracks in Beirut are blown up by suicide-bomb terrorist; 241 lives are lost.



WORLD PHOTOS: UPI/BETTMANN

1984 COMPUTER INDUSTRY

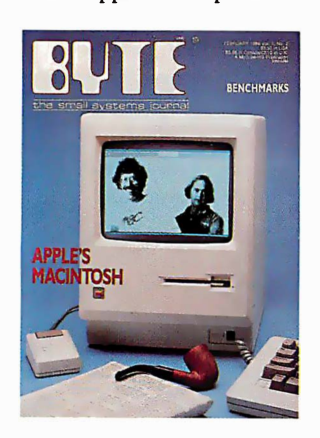
BYTE
THE SMALL SYSTEMS JOURNAL

FEBRUARY–MARCH
BYTE covers the new Macintosh and the design team behind it. And we devoted an entire Theme to the thorny issues of benchmarking and performance evaluation. In March our "Feigning Reality" Theme looked at using the computer to simulate real-world activities.

MAY
"Professional Computing," how microcomputers were faring in the workaday world, was our May Theme. In a feature, we noted that Macintosh pricing "turns out to be more expensive than expected."

JULY–SEPTEMBER
Computer users' fascination with video continued with our July Theme, while in August we looked at Modula-2 in depth. Despite the IBM PC's success, nothing could save the IBM PCjr we reviewed in August. BYTE produces its first yearly IBM-only special issue. Graphics gets its own Theme in September.

OCTOBER–NOVEMBER
For October, the BYTE staff looks at the IBM PC AT and the Theme is databases. In November, "New Chips" was the Theme, and we first looked into Soviet computing with "AGAT: A Soviet Apple II Computer."



Satellite Software International brings out WordPerfect for the IBM PC, Victor 9000, DEC Rainbow, Zenith Z-100, and Tandy 2000. ▷

```
                         WORDPERFECT

   This is an actual picture of how WordPerfect looks on the
screen.

   There is a status line below to show you exactly where
you are in the document.

   Bold, underlining, or both appears right on your screen
as well as
                      centering,
                                              flush right,

        margin settings (this one has been changed
        to 20 and 60),

            and temporarily indented paragraphs
            such as this one which brings both
            the left and right margins in.

   All this with no codes to clutter your screen!_

                              Doc 1  Pg 1  Ln 22  Pos    61
```

Hewlett-Packard introduces the LaserJet and the HP 110, an early 80C86 laptop. ▽





◁ **More of the fruit motif: Britain produces the Apricot PC.**



△ **Data General introduces the DG/One laptop.**

With Lotus's **Symphony**, the era of integrated packages gets under way; the next month, Ashton-Tate introduces **Framework**.

Visionary Alan Kay leaves Atari to join Apple.

AT&T tries to muscle into the game with its first DOS machines, but the **PC 6300** is greeted mostly with yawns.

Motorola introduces the **68020**.

Former Commodore president Jack Tramiel buys Atari from Warner Communications.

IBM also announces **Top-View**, a multitasking windowing environment for DOS programs that never catches on.

Innovative Software (later Informix) introduces **Smart Software**.

Commodore Business Machines buys Amiga Corp.

Computer Associates buys Sorcim, the maker of **SuperCalc**.

Visicorp sells much-touted but never-delivered **VisiOn** package to Control Data Corp.

Visicorp merges via stock swap with Paladin Software.

George Tate, cofounder of Ashton-Tate, dies. There was no Ashton; Tate's partner was named Lashlee.

Lotus announces **Jazz**, which went on to become the company's first flop.

Exactly one year after reaching its historic peak, the SIA's book-to-bill ratio reaches its lowest point ever: 0.64.





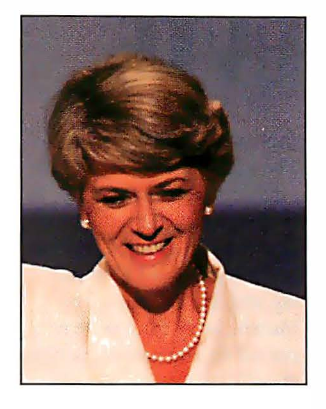
△ **Apple unveils the Macintosh for $2495.**

◁ **Apple introduces the Apple IIc.**

IBM introduces the AT, with a 286, 256K bytes of RAM, a 16-bit bus, and a new high-density floppy disk drive for $5469.







Geraldine Ferraro becomes the first woman on a major party ticket, but she can't save Mondale; Reagan is reelected in a landslide.

Indian Prime Minister Indira Gandhi is assassinated by Sikh extremists.

U.S. Census Bureau reports that 15 million Americans own home computers but only 53 percent use them.

Soviets pass up the summer Olympics in L.A.

Deadly gas leak at Union Carbide plant in Bhopal, India, kills 2500—the worst industrial accident in history.



Bishop Desmond Tutu of South Africa is awarded the Nobel Peace Prize.

WORLD PHOTOS: UPI/BETTMANN

1985 Computer Industry

BYTE
THE SMALL SYSTEMS JOURNAL

January–April
The Mac begins to make inroads into our readership, as evidenced by the number of Mac-related articles. February's Theme was Computing and the Sciences. In March, Jerry Pournelle reported on Hackercon, a first-of-its-kind convention. AI gets plenty of ink in April, with top names in the field speaking their minds.

May–August
Smalltalk gets a mini-treatment in May, emphasizing the growing interest in object-oriented programming. "Inside AppleTalk" hinted at the future of Apple-related networking. BIX is announced. Computers and Space is the July Theme. "The Amiga Personal Computer" is covered in August, as are the declarative languages.

September–October
BYTE's 10th anniversary issue is published in September! October's "Simulating Society" Theme presented the idea of modeling and predicting using personal computers. BYTE's second IBM Special Issue hits the streets, reflecting the growing influence on the industry.

November
"Five C Compilers for the Macintosh" indicated that the Mac was gaining ground. Years earlier, only MS-DOS machines would have had multiple compilers to choose from. And "CD-ROMs and Their Kin" reinforced the coming optical revolution.

December
A "Computer Conferencing" Theme indicated that BYTE readers and the technology were ready to link up via BIX, BBSes, and other on-line electronic services.



AT&T announces the Unix PC, a 68010-based, $5600 machine that failed to establish Unix as a PC standard.

Commodore's Amiga 1000 features a multitasking, windowing operating system and sells for $1295.



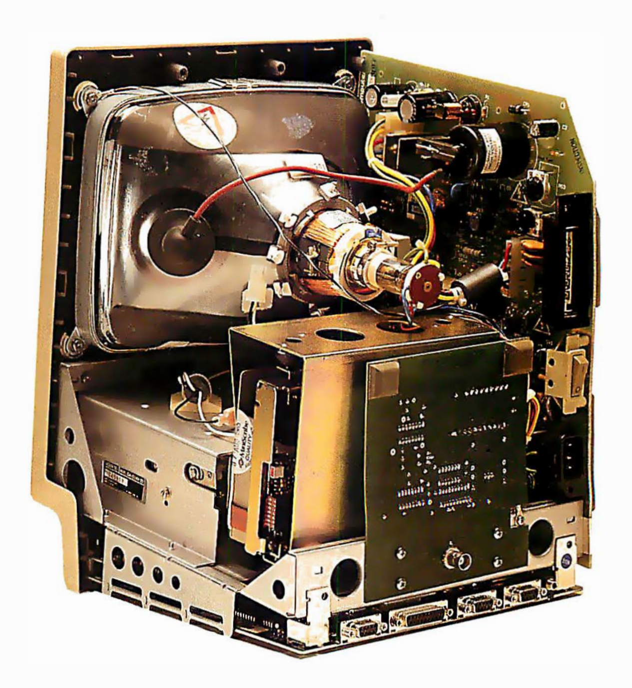
Atari announces the Atari 520ST at CES.



Tandy announces the Model 200 laptop.

General Computer HyperDrive, a hard disk retrofitted into the Mac, becomes available; it's a short-lived market niche.





Coleco gives up on the Adam and writes down the loss.

One year after the Mac, Apple unveils the **Macintosh Office**, which includes AppleTalk and the Laser-Writer, and renames the doomed Lisa the Mac XL.

DEC admits it has stopped making the **Rainbow**, and then announces a new and equally unsuccessful version.

IBM, Toshiba, NEC, Fujitsu, Hitachi, and Mitsubishi all report 1-MB DRAM chips at the annual ISSCC.

IBM says it will drop the **PCjr** in April.

Apple discontinues the Lisa.

Digital Research ships **GEM** to end users; the interface was eventually used by the Atari ST and Ventura Publisher.

Microsoft releases **C 3.0**, its first homegrown C.

Dayna Communications announces MacCharlie, which lets a Mac run IBM PC software; many readers think it is an April Fools' joke. ▽



Intel sues NEC over **V20** and **V30**.

Microsoft announces **Excel** for the Mac.

Lotus finally ships Jazz.

Lotus and Intel announce an expanded memory specification that will eventually become **LIM/EMS 3.2**, and Intel announces **Above-Board**.

Lotus acquires Software Arts; stops shipment of VisiCalc.

Aldus introduces the original **PageMaker** for the 512K-byte Mac.



△ **Toshiba introduces the fantastically successful T1100 laptop.**

Quarterdeck Office Systems releases the **Desqview** windowing program multitasker.

Steven Jobs resigns from Apple.

Ansa introduces **Paradox**, later to be bought by Borland.

IBM introduces its **Token Ring** network.

Intel announces the **386**.

Microsoft finally ships Windows 1.0.



Gorbachev comes to power in the U.S.S.R.

Reagan and Gorbachev hold first superpower summit in six years, in Geneva.

Nevado del Ruiz volcano erupts in Columbia, killing 22,940.

South Africa imposes state of emergency, including press censorship.

Mexico City earthquake, 8.1 on the Richter scale, kills at least 4200.



Ethiopian famine kills millions, spurs worldwide relief effort, including "Live Aid" concert in Philadelphia and London.

WORLD PHOTOS: UPI/BETTMANN

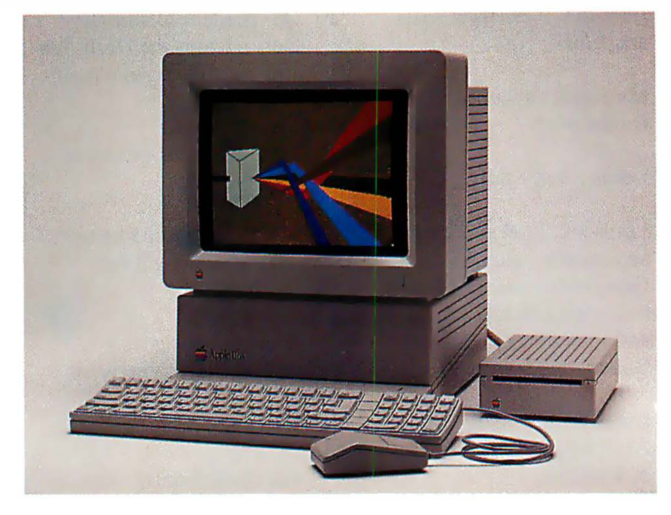
1986 Computer Industry



January–March
The Atari 520ST was the focus of a Product Description in January, and the 1040ST was previewed in March. It's interesting to note that despite the Atari's and Amiga's potential, the general-use personal computer industry remained mostly divided between the MS-DOS and (growing) Macintosh camps. February's "Text Processing" Theme hinted at the future popularity of desktop publishing. In March, "Homebound Computing" reflected a growing interest in telecomputing.

June–July
We look at the Macintosh Plus in a Product Description and conclude that this is the machine that Apple should have made much earlier. And the Theme is (brass fanfare) "Computers and Music." The growing acceptance of—and even demand for—MIDI-linked music equipment begins to change foundations of musical creativity. In July, the "Engineer's Toolbox" Theme reflects the increasing use of personal computer assistance in the engineering disciplines.

August–December
The traditional August "language" Theme is "Object-Oriented Languages," and their potential continues to be explored today. September's "68000 Machines" Theme showed that the Intel microprocessors were not everyone's choice. We previewed the Apple IIGS in October and the Compaq Deskpro 386 in November. The proliferation of PC products and peripherals led to the BYTE "23 Modems" group review process, the forerunner of today's Product Focus.



◁ **The Apple IIGS is introduced on September 15.**



◁ **IBM introduces the RT PC, its first and not very successful venture into RISC-based desktop workstations.**

IBM introduces the PC Convertible, a 12- to 16-pound battery-powered laptop for $2000, which becomes its second unsuccessful portable. ▽





Sperry and Burroughs agree to merge into Unisys.

Little-known Advanced Logic Research announces the first 386 PC, the **Access 386**.

U.S. and Japan sign semiconductor trade agreement to halt chip dumping.

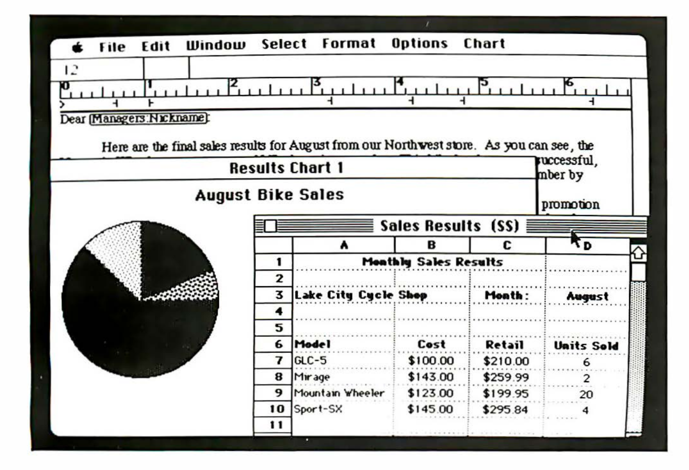
Peter Norton Computing announces the **Norton Commander**.

Corporation for Open Systems formed.

U.S. International Trade Commission rules 5-0 that Japanese manufacturers are dumping 256K-byte RAM chips in the U.S., setting the stage for the semiconductor trade agreement and later RAM crisis.

Motorola announces the **68030** microprocessor.

Lotus announces **HAL**.



Compaq introduces the Flex architecture Deskpro 386, its first 386 and the first Compaq machine to include a separate memory bus. ▽

△ **Microsoft introduces Works for the Mac.**



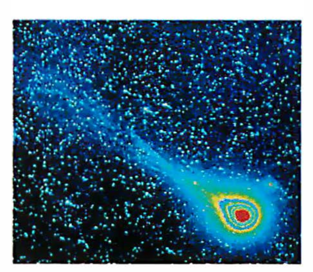
WORLD



Challenger explodes, causing national outpouring of grief.

Ferdinand Marcos flees the Philippines after 20-year rule; wife Imelda leaves behind massive shoe collection.

Swedish Premier Olof Palme shot dead while walking home from a movie in Stockholm.



Halley's Comet returns but is hard to see.

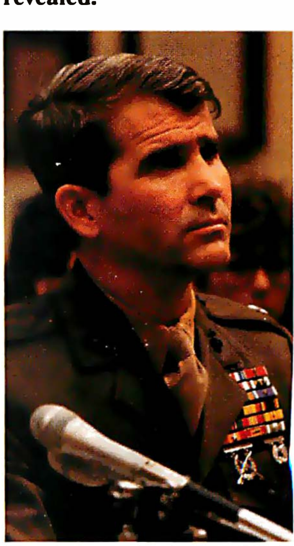


Statue of Liberty 100th birthday celebration is an exercise in heart-swelling pride and lovable vulgarity.



Chernobyl meltdown drives nail in the coffin of the nuclear industry, heightens awareness of environmental problems in the Eastern bloc.

Iran-Contra scandal revealed.



WORLD PHOTOS: UPI/BETTMANN

1987 COMPUTER INDUSTRY

BYTE
THE SMALL SYSTEMS JOURNAL

FEBRUARY–MARCH
We look at IBM competitors Advanced Logic Research and Compaq. Commodore tries again with a preview of "The Commodore A2000"; Borland makes points with "Turbo BASIC" and Turbo C.

APRIL–JUNE
The Mac II arrives at BYTE in April. Its open-ended design might have made all the difference had it arrived closer to the IBM PC's announcement. Desktop publishing is May's Theme, echoing a ground swell of interest. The PS/2s, targets of the June First Impression, redefine IBM's microcomputer standards. OS/2 is born. Zoomracks receives a lukewarm review but will become a legal challenge to Apple for attributes embodied in HyperCard software.

JULY–SEPTEMBER
Benchmarks are a hot topic, and BYTE rolls out an attempt to fairly compare 386 and 68020 microprocessors. The "year of the LAN" resurfaces, but this time the Mac is included. We review six popular CAD programs, complementing July's review of five Mac CAD programs. "A Programmer's Introduction to OS/2" is only the beginning of the "operating-systems wars" that still rage.

NOVEMBER–DECEMBER
Long-dominated by Lotus 1-2-3, the spreadsheet race gets more interesting with Excel, Quattro, and PlanPerfect. The division between personal computers and workstations begins to blur as we look at "Workstation Technology" in the November Theme. In December, HyperCard gets a First Impression.

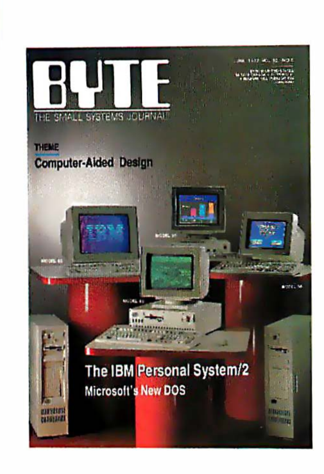


◁ **Compaq introduces the Portable III.**

Apple introduces the Mac II and the Mac SE. ▷



IBM introduces PS/2 line and OS/2, the first IBM 386 (Model 80), and unveils its *M*A*S*H* ads. ▷





Paul Allen, the cofounder of Microsoft, talks about his new company, Asymetrix, and its product plans. **ToolBook** will show up nearly 3½ years later.

Traveling Software introduces **LapLink** file transfer software for $130.

IBM announces 4-MB DRAM chips.

Lotus files a look-and-feel lawsuit against Paperback Software and Mosaic Software, charging they have unfairly copied 1-2-3.

The Sematech consortium of chip makers is announced in Washington, D.C.

IBM announces Systems Application Architecture.

Atari and Commodore settle outstanding litigation.

Lotus signs 10-year agreement to develop software for IBM mainframes, starting with **1-2-3/M**.

Lotus announces **1-2-3 release 3.0**.

Microsoft and 3Com announce intention to develop OS/2 Lan Manager.

Borland acquires Ansa Software and gets Paradox.

IBM introduces the **PC Convertible Model 3**.

IBM introduces the **PS/2 Model 25**.

Apple introduces **HyperCard**, which proves to be enormously popular.

To merge the expanded memory specifications of LIM/EMS 3.2 and AST, the companies join to announce **EMS 4.0**.

Compaq announces it won't sell a clone of the PS/2s, although it has designed such a system.

Microsoft announces **Excel** for the PC, the first real Windows application.

Lotus announces **Agenda**, the product that brings vim to PIMs.

AT&T and Sun agree to share Unix technology.

IBM hooks up with Steve Chen, formerly of Cray, and announces plan to produce a 64-CPU parallel system in the early 1990s.

Borland introduces Quattro.

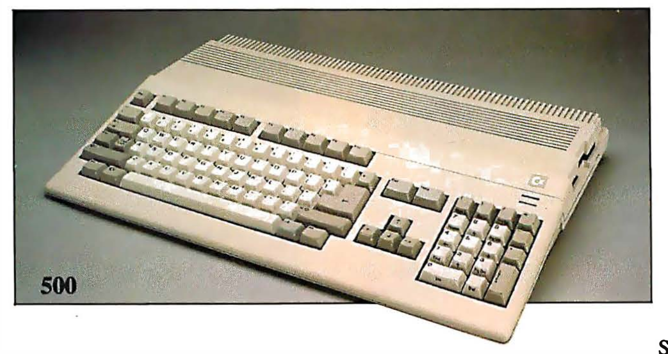




Commodore announces the Amiga 2000 and 500.




2000


500



Reagan and Gorbachev sign the INF nuclear-reduction treaty.

Canada's Meech Lake Accord is passed, but it fails to win approval within three years.

Palestine Intifada breaks out in Israel.




NEW YORK POST

CRASH!

Wall Street's blackest day rocks nation

...but no 'blood in the streets'

Wall Street crash wipes 508 points off the Dow.

WORLD PHOTOS: UPI/BETTMANN

1988 COMPUTER INDUSTRY

BYTE

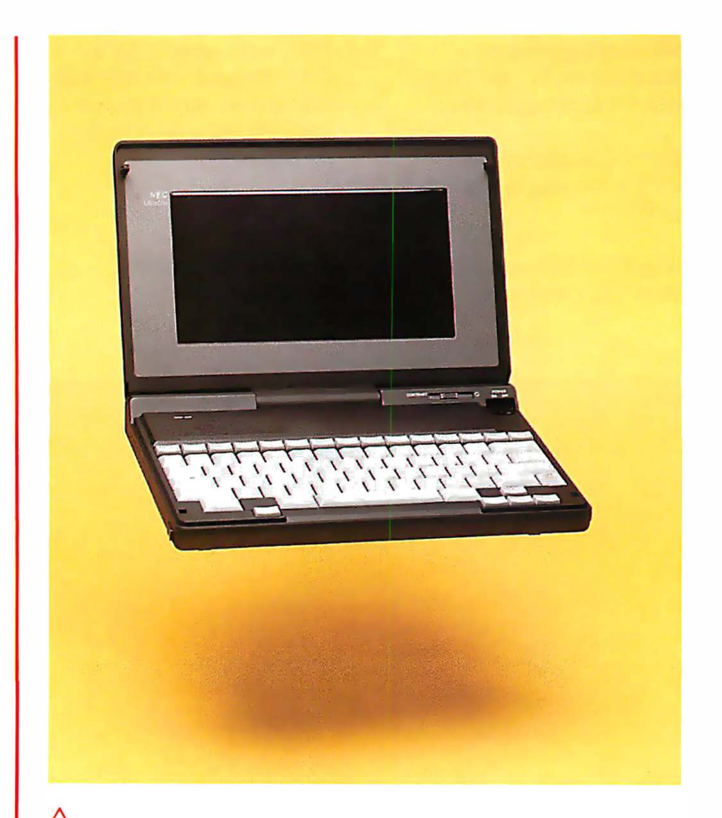
FEBRUARY
The Compaq Deskpro 386/20 reigns as performance champion; third-party Micro Channel memory boards reflect interest in the PS/2 line.

APRIL–JUNE
April has First Impressions of Microsoft language products that bridge to OS/2. The In Depth is "Memory Management." May's Product Focus on "Word Processors for Desktop Publishing" concludes that word processing capabilities are not yet up to desktop publishing products. In June, BYTE unwraps its new suite of benchmarks. We focus on 9600-bps-and-beyond modems. We review OS/2 Standard Edition.

JULY–AUGUST
Sun's 386i shows that the distinction among PCs, workstations, and minicomputers is fogging up. July also has a First Impression of OS/2 Extended Edition. In August, in addition to our regular coverage of the Mac, we begin a series of Mac supplements.

SEPTEMBER–OCTOBER
September's cover story is a First Impression of the IBM Model 70 and the Tandy 5000 MC. The portable Toshiba T5100 and GRiDCase 1530 show you *can* pack power into small packages. We review 20 affordable 386s, look at Presentation Manager, and cover five Mac scanners.

NOVEMBER–DECEMBER
The NeXT Computer tries to usher in a new era by hitting the education market with a technologically advanced system. ALR's FlexCache 25386 sets a new speed record. The Mac IIx is covered in December. Six months' worth of system benchmarks are provided.



△

NEC announces the 4.4-pound UltraLite.



Microsoft and Ashton-Tate team up to announce **SQL Server**.

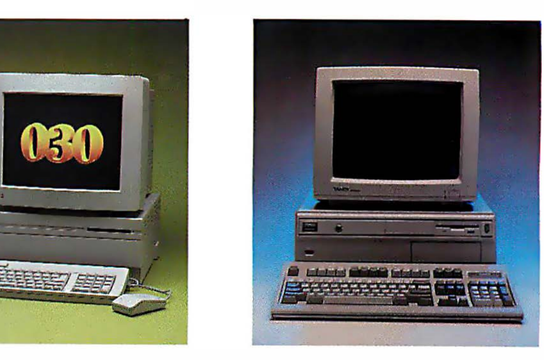
Apple and DEC announce agreement to cooperate.

Informix announces **WingZ**, a new spreadsheet for the Mac.

MIT and 11 companies announce consortium to develop industry standards for workstations.

Tandy introduces the Tandy 5000MC, the second Micro Channel clone (Dell was first), and announces Thor, a system for rewritable, erasable compact disks, which still has not shipped but is supposed to be available in 1990 for $500.





Apple announces the Mac IIx, 10 to 15 percent faster than the Mac II. ▷

Compaq introduces the SLT/286. ▷





NEC asks the court to invalidate Intel's copyrights on the 8086/8088.

The memory shortage is in full swing.

Apple files suit against Microsoft and Hewlett-Packard in federal district court, charging that Windows infringes on Mac copyrights.

Lotus announces delay in 1-2-3 release 3.0.

MIPS announces its RISC processor.

AT&T plans new software to make Unix easier to use.

Quarterdeck and Phar Lap develop the Virtual Control Program Interface (VCPI), the first standard for addressing 386 virtual mode with existing DOS applications.

IBM announces plan to license **NextStep** from Steve Jobs.

Maxtor introduces the first magneto-optical rewritable optical disk drive.

The Open Software Foundation is announced; it plans to base its version of Unix on IBM's AIX.

AMD introduces the **29000** 32-bit microprocessor.

Intel announces the **386SX**.

Caere announces **OmniPage**.

Sun, Texas Instruments, and Cypress announce agreement to promote SPARC.

Intel buys the DVI technology from GE.

The NeXT cube is announced at gala event in San Francisco. ▷



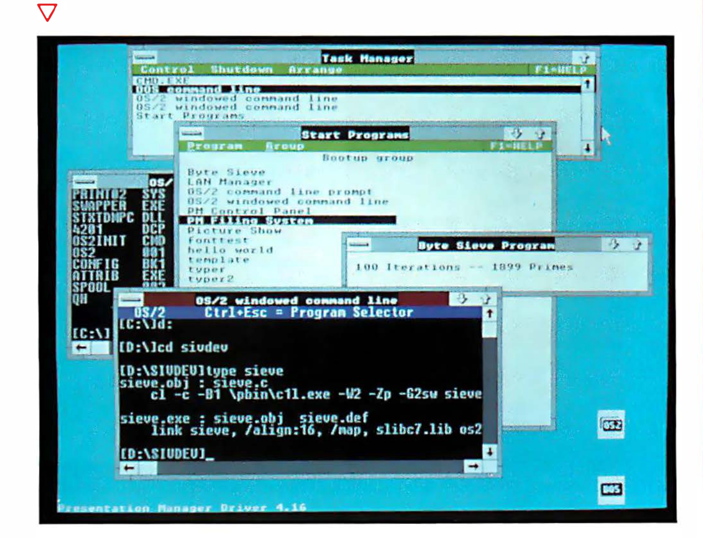
The EISA consortium, also known as the "Gang of Nine," is announced; it will develop a 32-bit bus alternative to IBM's Micro Channel.

Ashton-Tate ships **dBASE IV** after a series of delays.

The ARPANET worm created by "bored" Cornell graduate student Robert T. Morris Jr. wreaks havoc at an estimated 6000 sites around the U.S.

IBM and Microsoft ship OS/2 1.1 with Presentation Manager.

▽



Ashton-Tate files a look-and-feel lawsuit against Fox Software and SCO on the first day of Comdex.

The Systems Performance Evaluation Cooperative (SPEC) is formed between Hewlett-Packard, Apollo, MIPS, and Sun.

Brier announces 21-MB floppy disk drive.

IBM ESD head William Lowe leaves for Xerox, and James Cannavino steps in.

OSF announces its selections for the software components that will make up **Motif**: DECWindows and a modified PM from Microsoft and Hewlett-Packard.



George Bush defeats Michael Dukakis for the presidency.

Irving King Jordon becomes first deaf president of Gallaudet University.

U.S.S. Vincennes shoots down Iranian civilian airliner, killing 290.

A pair of runners named Joyner capture our fancy, as Jackie Joyner-Kersee and Florence Griffith-Joyner take home Seoul gold.

Shroud of Turin is declared to date only from thirteenth century.

Earthquake rocks Soviet Armenia, killing 25,000.

Pan Am flight 103 is bombed over Scotland.



WORLD PHOTOS: UPI/BETTMANN

1989 COMPUTER INDUSTRY

BYTE

JANUARY–MARCH
We inaugurate the BYTE Awards, a yearly tip of the hat to overachieving products. "The X Window System" emerges from MIT to an enthusiastic audience, and the growing interest in PC communications is addressed in an expanded In Depth. The powerful Mac SE/30 is the February cover story. In March, we examine the 386-versus-286 question.

APRIL–JUNE
The TRON project looks ahead to standardizing computer data and communications. Two workstations from Sun fuel the PCs-versus-workstations debates. Unix gets expanded coverage in May, and Intel's high-speed i860 processor receives a First Impression. In June, speed is again the hot topic, with First Impressions of two new 386 machines.

JULY–SEPTEMBER
Graphical user interfaces are explored in "A Guide to GUIs." In August, laptop technology takes a leap forward with the Agilis and Zenith entries. The first 486 machine is made in the U.K.! Four multiuser operating systems are the subjects of a Product Focus, and we look at LANs in a special supplement.

OCTOBER–DECEMBER
Arriving from Apple are the long-awaited Mac Portable and IIci. We spotlight optical technology in both the Product Focus and the In Depth. If bus-related things weren't complicated enough, "EISA Arrives," in the form of the Hewlett-Packard Vectra 486 PC. With 32-bit processors comes the In Depth software topic "32 Bits and Above." In December, the software development furnace is stoked by a Product Focus on nine "CASE Tools."



◁ **DEC introduces its first RISC-based workstation, the DECstation 3100.**



Apple introduces the SE/30, a $4369 compact Mac with a 68030. ▷



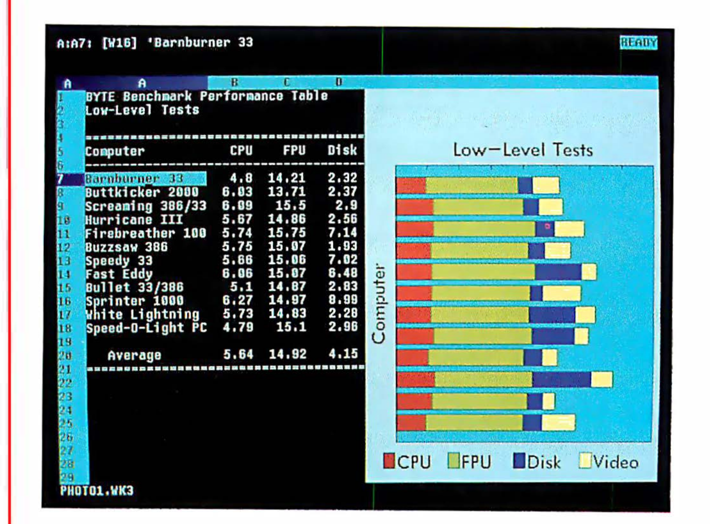
◁ **Sun announces the 12.5-MIPS SPARCstation 1 for a base price of $8995.**

After a year's delay, Lotus finally ships its 3-D spreadsheet, 1-2-3 release 3.0, along with a junior cousin, release 2.2. ▽

Apple announces the top-of-the-line Mac IIci and the long-awaited Mac Portable, whose active-matrix screen and built-in trackball are overshadowed by its 16-pound weight and nearly $6000 price tag. ▽

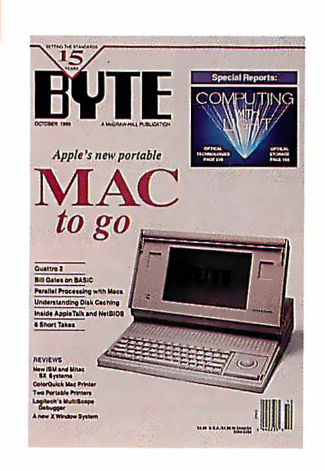






Computer	CPU	FPU	Disk
Barnburner 33	4.8	14.21	2.32
Buttkicker 2000	6.03	13.71	2.37
Screaming 386/33	6.09	15.5	2.9
Hurricane III	5.67	14.86	2.56
Firebreather 100	5.74	15.75	7.14
Buzzsaw 386	5.75	15.07	1.93
Speedy 33	5.66	15.06	7.02
Fast Eddy	6.06	15.07	6.48
Bullet 33/386	5.1	14.87	2.83
Sprinter 1000	6.27	14.97	8.99
White Lightning	5.73	14.83	2.28
Speed-O-Light PC	4.79	15.1	2.96
Average	5.64	14.92	4.15

Poqet Computer Corp. announces a 1-pound DOS PC for $1995. ▷





WORLD

Borland unveils **Paradox 3.0**.

Informix finally ships WingZ for the Mac.

Intel takes the wraps off its **i860** superscalar RISC chip. It also announces the **i486**.

Apple introduces the powerful, compact **Mac IIcx** and has an instant hit.

Hewlett-Packard announces that it will acquire Apollo.

Texas Instruments unveils the **TIGA-340** graphics standard.

Adobe announces **Adobe Type Manager**.

Apple discloses details about the **System 7.0** Mac OS.

Novell announces **NetWare 386**.

IBM unveils **OfficeVision**, a multiplatform office software system that takes advantage of PM and is a key part of the SAA strategy.

Microsoft and IBM announce OS/2 1.2.

Borland announces **Turbo Pascal 5.5** with object-oriented extensions.

NEC takes a shot at Nintendo with the 16-bit **Turbografx-16** home video game.

Seven computer and semiconductor firms plan to form a DRAM consortium called U.S. Memories, but the plan fails for lack of money.

Computer Associates acquires Cullinet and Cricket Software.

Hewlett-Packard ships **NewWave**.

ALR announces the first PC with an EISA bus, a $13,000 486 box.



Compaq announces the 8086- and 286-based **LTE** notebook PCs.

Microsoft ships Excel for OS/2 PM, the first OS/2 spreadsheet.

Headstart Technologies introduces a PC with built-in CD-ROM at Comdex.

Lotus starts shipping **Notes**, a high-ticket groupware application that raised the bar.

GRiD Systems announces the handwriting-recognizing GRiDPad.

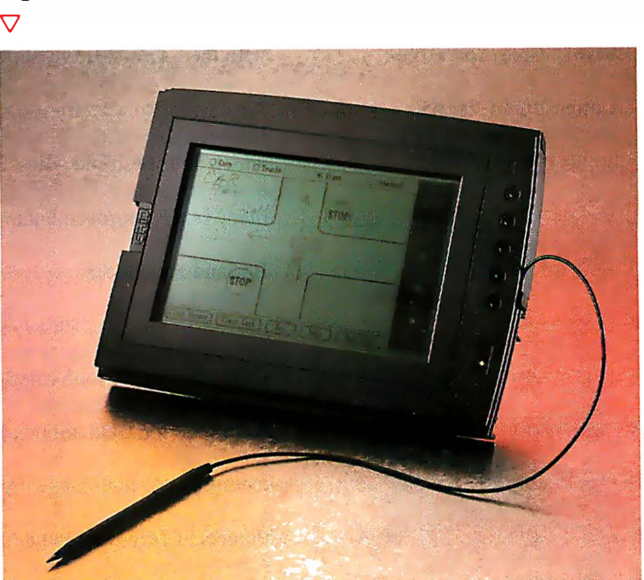


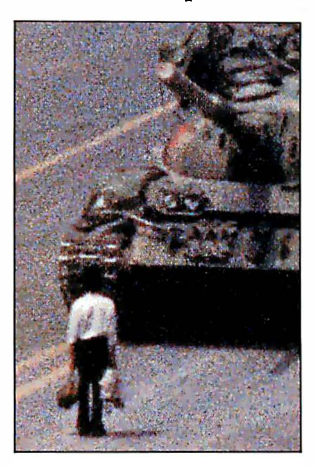
PHOTO: MEL LINDSTROM

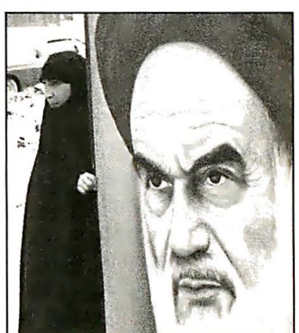
Compaq takes the plunge into multiprocessing PCs with the EISA-based Systempro.

IBM tries again in portables with the 386-based Model P70.

Exxon Valdez oil spill awakens environmentalism.

China crushes protesters in Tiananmen Square.





Ayatollah Khomenei dies.

Hurricane Hugo ravages the Caribbean and South Carolina.

Earthquake rocks the San Francisco Bay Area.



A dizzying wave of popular uprisings transforms Eastern Europe, and the Berlin Wall comes down.

WORLD PHOTOS: UPI/BETTMANN

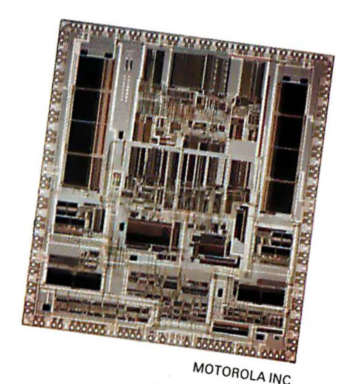
1990 Computer Industry

BYTE

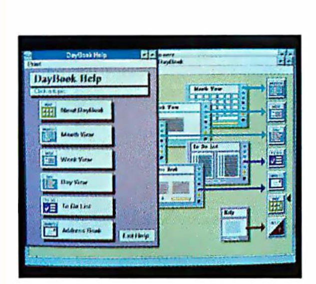
January–April
We chronicle IC technology in "The State of Chips." Computers and images come together with sound in February's "Multimedia" In Depth. "The BYTE Unix Benchmarks" tackle a whole new world. Apple's "wicked fast" Mac IIfx is our April cover story. And just when you thought that your high-speed 286 was going to last a while longer, we looked at 23 25-MHz 386 motherboards to tantalize you. The quest for speed is never satisfied.

May–August
With the emergence of multimedia, the Commodore Amiga 3000 is perhaps right on time. AST and ALR serve up a pair of 33-MHz dervishes, and we feast on "Desktop Supercomputing." One of the industry's worst-kept secrets, Windows 3.0, is our June cover story. Another "year of the LAN" goes by, and we devote our State of the Art (née In Depth, née Theme) section to networking. We investigate man/machine interfaces in July and devote two months of First Impressions to sample applications for Windows ("looks like we finally got it right") 3.0.

September
BYTE's 15th anniversary reflects a mature but still-growing industry. How fitting that after 15 years word processing, one of the first and probably most-used applications ever, is this issue's Product Focus. Also, features this month include "The Creation of the IBM PC," written by David J. Bradley, who was there when it all began, and "Personal Computing in Eastern Europe." Now that The Wall is down, what impact will the Iron Curtain countries have on microcomputing?


MOTOROLA INC.

Motorola unveils the 68040 CPU.



Microsoft announces the much-awaited, overhyped, and exciting Windows 3.0 (shown here running ToolBook from Asymetrix).

C-Cube introduces an image-processing chip based on the JPEG algorithm.

Radius announces the **Pivot** display for $1690.

Lotus ships 1-2-3/G, its spreadsheet for PM.




IBM jumps back into the workstation market with the RS/6000 family.

PHOTO: JACK PURYEAR

Dragon Systems ships the 30,000-word **Dragon Dictate** voice-recognition system, which runs on a fully loaded 386 and costs $9000.

Sharp demonstrates the **6220** notebook PC, a 4-pound 286 with a backlit VGA screen and a 20-MB hard disk drive for under $4000.

Q/Cor begins shipping 20-MB "Flextra" floppy disk drives made by Brier.

Lotus and Novell announce plan to merge, which later falls through.

Commodore gets serious with the $3300 **Amiga 3000**.

Apple unofficially announces HyperCard 2.0, which adds multiple windows, color support, and many other improvements.

Borland announces **Turbo C++**.

Eleven companies agree to DOS Protected Mode Interface (DPMI), a standard technique for DOS applications to access extended memory.

Pioneer, LMSI, and Panasonic all announce rewritable WORMs at Comdex.

Adobe introduces **PostScript Level 2**, the first major upgrade to the page-description language standard in six years.

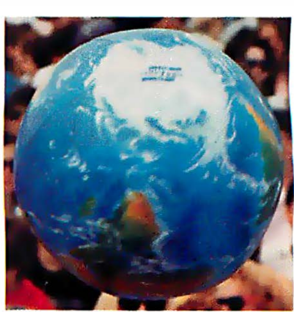
IBM unveils the entry-level **PS/1**, a second attempt to crack the home and home-office PC market.

World

Robert Noyce, cofounder of Intel and inventor of semiconductors, dies at 62.

Perrier is recalled for benzene contamination.

Earth Day 1990 is about hope and hype.



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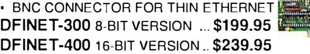


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PERSONAL COMPUTING IN EASTERN EUROPE

The collapse of state-run economies has left Eastern European countries in a state of technological chaos

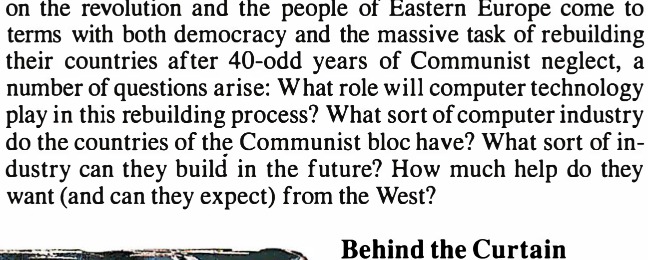
Colin Barker

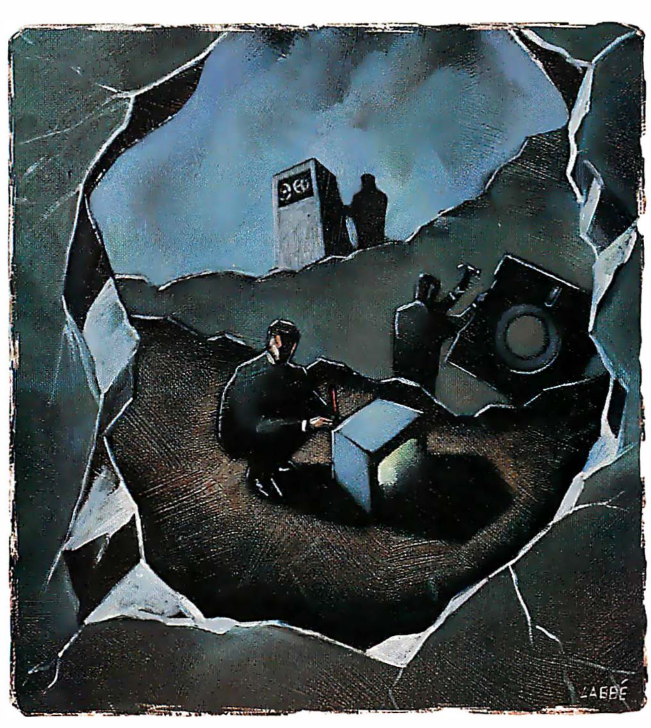
The revolution that spread democracy through Eastern Europe last year—epitomized by the destruction of the Berlin Wall—was driven by a combination of economic collapse and popular discontent. But economic stagnation and unpopular governments are not new in the East (i.e., Eastern Europe).

What gave this movement real force and cohesion across half a continent and seven different countries was technology, especially information technology: TV and radio, telephone lines and fax machines, and personal computers and desktop publishing all made it difficult for dictatorial Communist governments to control the flow of events.

Without complete control of the media for propaganda, even the brute force of a massive secret police force was not enough to suppress popular dissent. Controlling the printing presses is not enough if people can use personal computers to produce inexpensive newspapers and then distribute the copy across telephone lines to the far reaches of their country. Nor does owning the only TV station help, if the public's TVs can also pick up unbiased news from elsewhere.

In 1989, TV made those of us on the other side of the Iron Curtain witnesses to the first revolution facilitated by the humble PC. Now, as the dust settles on the revolution and the people of Eastern Europe come to terms with both democracy and the massive task of rebuilding their countries after 40-odd years of Communist neglect, a number of questions arise: What role will computer technology play in this rebuilding process? What sort of computer industry do the countries of the Communist bloc have? What sort of industry can they build in the future? How much help do they want (and can they expect) from the West?





Behind the Curtain



Until recently, not much was known about the computer industry of Eastern Europe, since many of the nations took great care to keep their activities a secret. While more information has emerged since *glasnost* began five years ago, there is still much that we in the West do not know.

For example, most observers agree that the countries of the East are five, 10, 20, or even 30 years behind the West in some areas of technology. The minicomputer most used in the East is based on technology first launched in the West in 1975. However, that doesn't necessarily mean that the East will need 15 years to catch up with the latest Western minicomputers.

An incident that occurred in the early 1970s reveals the

continued

confusion surrounding the West's assessment of the computing and electronic capabilities of Eastern Europe: A Soviet pilot defected to the West in one of his country's latest fighter aircraft. Western analysts were amazed to discover that air-to-ground communication was conducted via a VHF radio that used vacuum tubes rather than transistors. Was this aircraft a "plant," designed to make the West believe the Soviets were farther behind in technology than they really were? Or—as they suspected—did Soviet pilots truly rely on obsolete technology for their front-line communications? The question remains unresolved to this day.

Back to the Basics

While the Soviet Union and parts of Eastern Europe can produce some very advanced-looking technology, the secondary technology is way behind the West. As a visitor to Moscow five years ago, I was struck by the relatively good quality of the Soviet-made color TV in my hotel room. Yet I was appalled at a hotel electrical system that was so poorly put together that you needed to wear rubber boots to safely operate the light switches or elevator buttons. The showpiece Park of Economic Achievement's technology pavilion could boast some fairly up-to-date 16-bit computers, but the domestic appliances on sale in the GUM department store would not have looked out of place in a British store in the 1950s.

Similarly, while the large state industries and government departments have some reasonably sophisticated mainframes and minicomputers, personal computers are few and far between. Those personal computers built in the East are crudely manufactured, and any systems from the West are usually obsolete machines based on Intel 8088 or 8086 processors.

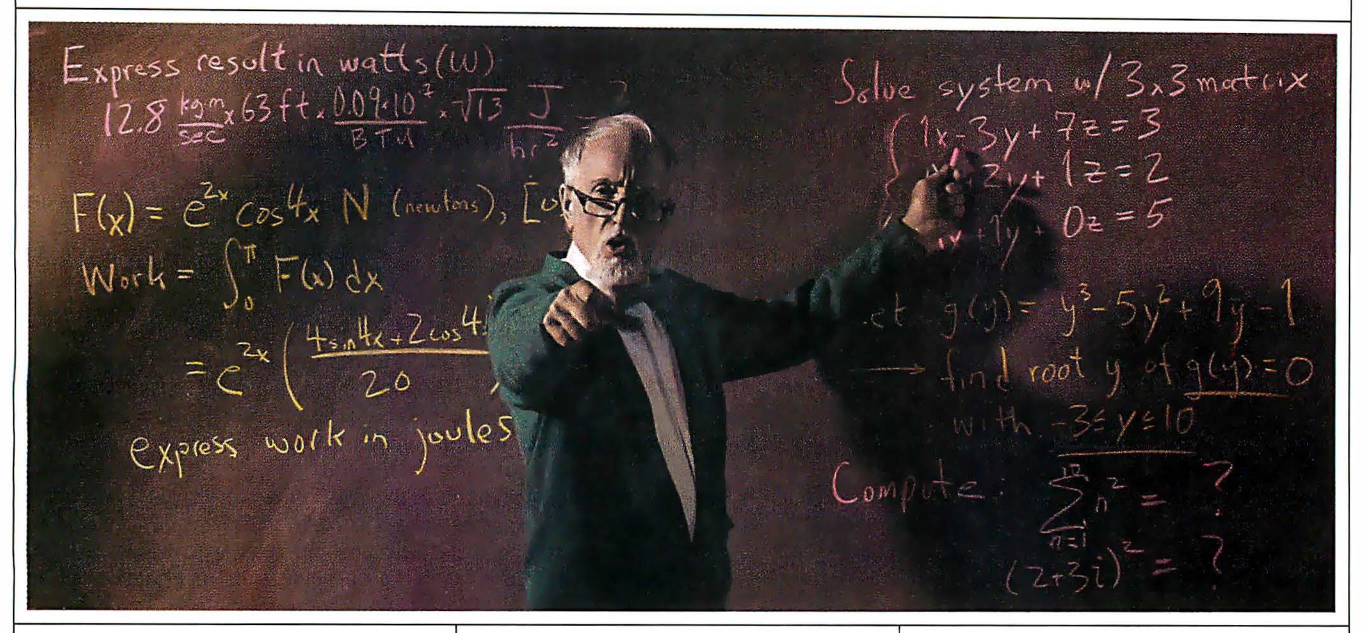
In general, microcomputer use in Eastern Europe and the Soviet Union has been sporadic. There have been a number of reasons for this. One is the Coordination Committee on Export Controls, or COCOM, a body consisting of the NATO countries and Japan and Australia. COCOM was set up in 1949 to coordinate the various countries' export policies. The aim was to prevent the Eastern bloc from obtaining Western technology that could be militarily useful.

COCOM meets from time to time and imposes or lifts restrictions on different products. Generally, the committee lifts restrictions on older technologies as newer ones replace them in the West. For example, until recently, Digital Equipment (DEC) could sell PDP-11s to the East but not VAXes. Anyone in the West can export computers based on 8088, 8086, and 286 processors, but not the 32-bit 386 or i486 processors. The complete range of 32-bit Motorola 680x0 processors was also barred from export, so, while PC compatibles are used in the East, the Mac, the Amiga, and the Atari ST are virtually unknown.

The COCOM restrictions affect almost every type of technology imaginable, from fiber optics to TV. While some products are banned from sale to the East, others are simply controlled. Additionally, while preventing the Communist bloc from buying advanced microprocessors has slowed high technology there, it is the COCOM restrictions on manufacturing technology that have caused most of the problems for Eastern Europe and the Soviet Union.

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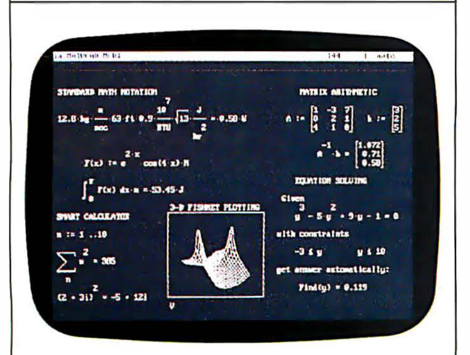
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The personal computer is the ultimate statement of freedom in computing, since it puts the power of computing and telecommunications into the hands of the individual.

Working Backward

Many factors contributed to the microcomputer revolution in the West, but one of the most important was the availability of cheap microprocessors. It is one thing to design a microprocessor; it is quite another to manufacture it inexpensively.

Computer scientists in the East can get their hands on any microprocessor in use in the West. However, reverse-engineering a chip once you have it is an incredibly labor- and time-intensive (though relatively unsophisticated) task. Using these techniques, scientists in the East can, and do, work out how to build any Western-designed microprocessor they choose.

The problem comes with the manufacturing process. Almost any type of component can be built well or badly, except a microprocessor. If a microprocessor isn't perfect, it won't work. The plants, machinery, and labor skills required to build microprocessors—especially at their current levels of sophistication—are immense. Manufacture requires ultra-clean rooms with advanced machinery, the purest of chemicals (which have to be specially produced), and an educated and disciplined work force. The countries of the Eastern bloc do not have the plants, machinery, or labor skills to manufacture microprocessors of any design less than 15 or so years old. They desperately need Western help to do this, or they will wind up importing all their chips. Up to now, of course, the COCOM restrictions have made it difficult for them to import any up-to-date processors at all, or even the older processors in any large numbers.

The same is true, to some extent, of microcomputer assembly. The Soviets and others can design microcomputers; they just find it very difficult to *build* them. Again, they are looking for Western help, and there is no shortage of companies in the West who want to help them.

Personal Politics

COCOM and the problems of manufacturing are not the only factors that have slowed the development of the personal computer in the East. Political problems have also played a part. Countries like Romania, Poland, and the Soviet Union have been run as dictatorships, and dictatorships must control information within their societies to survive. By controlling information, they can limit freedom. The personal computer is the ultimate statement of freedom in computing, since it puts the power of computing and telecommunications into the hands of the individual. That is why most of the East's computing effort has been put into mainframe and minicomputer development, and little into personal computers and distributed computing.

The access to and use of large-scale computer systems can be controlled and monitored by the authorities to ensure that they

continued

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are used only for purposes approved by the State. It is no surprise that, in a society that locks photocopiers and oversees their use, computers and their use are also closely guarded.

But these problems are starting to disappear, although not in a uniform way, across all the Eastern countries. COCOM is relaxing many of its restrictions on Eastern Europe and the Soviet Union. The Intel 386 processors are now derestricted, although there are still tight controls on the i486. The restrictions on machinery and plants for chip and computer manufacture have also been relaxed.

At the same time, many of the political restrictions on the use of computers have gone, although to understand that fully, it is perhaps best to look at some of the individual countries involved. Hungary and East Germany are commonly considered to be the two Eastern European countries that are the most advanced in computer technology.

Hungary: Leading the Eastern Division

Before the events of last year, Hungary was considered to be one of the most repressive countries in the East, yet one of the most economically advanced. These two facts are directly related. Janos Kadar was the man the Soviets put in control of Hungary after the uprising of 1956. In the early 1960s, he struck a deal with Moscow. In return for guaranteeing the complete suppression of opposition to the Communist government, he got a free hand to organize the Hungarian economy. Kadar started, and successive premiers continued, a liberal (for Eastern Europe) policy of encouraging trade and economic ties between Hungarian industry and agriculture and the West. As a result, Hungary has become Eastern Europe's biggest importer of goods from the West and the biggest exporter to the West. Private companies and cooperatives thrive in Hungary, and the institutions and industries there have decades of experience in dealing with the West.

As you would expect, Hungary has a great need for computing technology to keep this economic activity moving and has a long history of dealing with companies like DEC and IBM. Ashton-Tate and Borland, in particular, sell large amounts of software to Hungary, which has been almost unique among Eastern European countries in that it buys—rather than pirates—most of its Western software.

In hardware terms, the most common microcomputers are IBM PC, XT, and AT compatibles—the latter almost entirely based on 286 processors. Like all the countries of Eastern Europe, Hungary is subject to the rules of COCOM, so there are no legal 32-bit computers of any kind—although more than a few VAXes are said to have found their way there via incredibly circuitous routes and with no help from DEC. Most of the personal computers are imported either from Hungary's neighbors, such as East Germany, or from Western Europe, Taiwan, and Japan. What hardware industry the country has concentrates on the mid- to high end of computing, although Muszertechnika, the country's largest computer supplier, has been successful at selling personal computer products in the West. The company sells a range of hardware add-ins, including a SCSI controller for the PS/2s.

But Hungary is best known for the work done by its academics and engineers in computing theory and software development, particularly in AI. John von Neumann (of von Neumann architecture fame) was Hungarian and did much of his work at the University of Budapest, which maintains a thriving computer science department. The most notable commercial computing work to spin off from there is in expert systems, especially in pharmacology.

continued

East Germany: A Centralized Computer Economy

East Germany has suffered immense political and economic restrictions. Its secret police force was the largest in Eastern Europe, and its economy was rigorously controlled. Despite this, East Germany has the largest computer industry in Eastern Europe. The state-owned manufacturer Robotron makes everything from personal computers to mainframes. These systems are often, but not invariably, imitations of Western systems. Robotron manufactures a range of personal computers and launched a new range of PC compatibles at the CeBit Fair in Hannover this year.

Paradoxically, Robotron has the most to gain and the most to lose in the process of liberalization. The company has developed a mass of software aimed at manufacturing, including MRP II (for material requirements planning), CAD/CAM, and a variety of scientific packages. Some of these are already sold in the West. With teams of skilled programmers, Robotron could become a successful exporter.

But the hardware side, which is the core of the company's business, is more problematic. The hardware is not up to the quality of Western equipment, since Robotron has had a closed market to sell to in the East. As it becomes easier for East Germany's neighbors to buy from the West, that market will start to slow and eventually close unless the company changes rapidly.

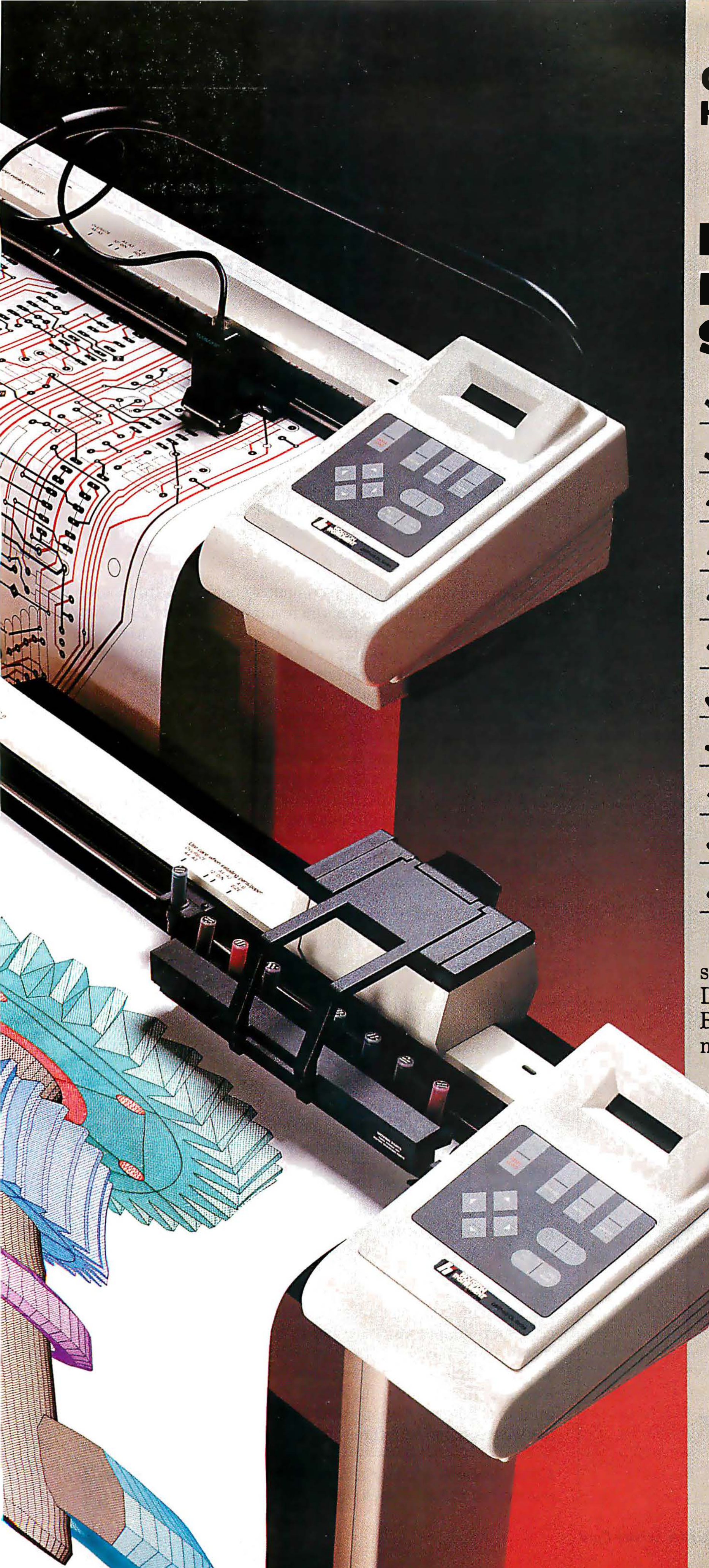
That change is likely to happen. As the move to German reunification gathers pace, Robotron will become a Western company. In fact, the West German computer giant, Siemens, has already expressed an interest in buying Robotron. If this sale goes through, Siemens will become the clear giant of computing in Europe, and Robotron will be a part of that. You can expect to see a lot of software emanating from Siemens, much of which will have been developed in East Germany.

Romania: Lagging Behind

While Hungary and East Germany have shown some promise in the computer field, Romania has lost out. Let a Romanian explain why. Nicora Paulian, whose company, Lixco, is based in Bucharest, makes the following assessment of the computer industry under Ceausescu:

> There is a very weak computer culture in Romania, due to the deliberate policy of the Ceausescu regime. For example, there was a "de-electronization program" which banned words like *computer*, *software*, *robot*, and so on from appearing in the mass media. As a result, the computer industry here lags some seven to 20 years behind Western technology. The problems came from the fundamental economics governing the society: central planning. Computing was introduced into the economy by force, so a kind of repulsion developed among people interacting with it. The Ceausescu regime tried to control the movement of data, but in effect the opposite happened as people used computers to exchange information against the regime.
>
> There are some IBM 360-like mainframes and PDP-11-like minicomputers. The majority of microcomputers

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are 8-bit systems based on 8080 or Z80 processors that have a 64K-byte RAM limit and run CP/M. They have stiff keyboards, flickering black-and-white displays, unreliable disk drives and media, and no modems.

There are a few hundred PC compatibles that are manufactured locally, and a few dozen imported ATs. They use MS-DOS. Unix is unheard of, and there are no Macintoshes, Amigas, or Ataris.

The home computer is the Sinclair ZX Spectrum, which has enjoyed tremendous success among hobbyists; its clones are being built by the thousands. If you talk about "personal computing" in Romania you are talking about the Spectrum.

It is felt by many observers that this situation was deliberately encouraged by the regime since there is little "subversive" potential in the Spectrum. Disk drives were hard to find, and printers were not allowed. In Romania you needed a permit from the police just to own a typewriter.

Lixco and other Romanian computer companies are rebuilding themselves in the wake of the revolution. While Paulian acknowledges the problems facing his country as it tries to take its place in the world's computer industry, he believes that there is an abundance of talent and creative ability in Romania's computer engineers and software writers.

The problems faced by Romanians, including Paulian, are immense: a lack of infrastructure, poor electrical supplies, terrible telephone services, few networks, and little data communications. His country's technological development is years behind the West, but all these things can be overcome. His company builds digital circuits and microprocessors. There are also plenty of people writing software. The biggest problem in software up to now has been the impossibility of marketing and selling it. The absence of copyright laws means that piracy is endemic.

Out of Tumult, Opportunities

All the countries of Eastern Europe, to a greater or lesser extent, face the same problems. They are starting the computer revolution from behind. They need resources, expertise, and training. They lack money.

At this writing, East Germany has changed over to West German deutsche marks, but other Eastern European economies are still based on currencies that are not acknowledged on the international foreign exchange markets. Consequently, they have no hard cash with which to pay for things. They can barter for goods, and most of the trade in the computer industry between the East and the West has been done this way through agents. The agents give the Eastern country the computer, take goods in exchange, sell the goods, and then pass on some of the money to the Western computer company. It may not sound like the best way of doing business, but it works.

Most of the economies of the Eastern countries are in disarray. Revolution and the uncertainty that follows it have taken their toll on whatever reserves these countries had. Western computer companies are going to have to make heavy investments in the East if they expect to reap any reward. But there are sound reasons for doing this. Suppliers from the Pacific Rim are already there in force. Most of the PC compatibles used in the Soviet Union come from countries like Taiwan. If the West is not to be left out, it will have to move quickly. ■

Colin Barker is a senior editor for BYTE in London. He can be reached on BIX as "colin.b."

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THE CREATION OF THE IBM PC

David J. Bradley

A little-known system, the DataMaster, drove many of the design choices for the original IBM PC

In August 1980, I had finished my work on what was to become the IBM System/23 DataMaster. The DataMaster was an Intel 8085-based system intended to run business applications written in BASIC. I had written some of the device-control code for that system and was looking at extending the design to the 8086 architecture.

I had heard rumors of a task force that was looking for a low-cost system design. The project sounded interesting, but I was enjoying the DataMaster work.

Then my manager called me in. He told me that IBM's Boca Raton division had been given the job of building a low-cost system. Management had assembled a team of engineers, and they needed someone to write the control code. I was to join 11 others in daily meetings at 8 a.m.

At that time, the design for the machine existed only as a few descriptive charts. A year later, on August 12, 1981, we announced the IBM Personal Computer. Here is the story of how we made the design decisions that shaped the IBM PC.

Humble Beginnings

The DataMaster program began in February 1978. Many of its design elements—the keyboard, for example—were later used on the IBM PC. This same development effort also produced a group of trained engineers already familiar with personal computer design.

The DataMaster was a single-element design. The one-piece package contained the keyboard, a 12-inch monochrome display, and a pair of 8-inch floppy disk drives. Although this design was suitable for the System/23 business environment, it didn't have the flexibility needed for a personal computer.

The DataMaster's 8-bit 8085 CPU was a very close relative of the 8080 and executed the same instruction set. During the design team's work on the DataMaster, we ran up against the limits of the 64K-byte address space and had to invent an external paging mechanism to address at least 256K bytes of memory. In designing this system, we became familiar with the Intel architecture and support chips.

The DataMaster system had a built-in BASIC interpreter, just like many of the personal computer designs of the time. During the DataMaster development, we "converged" our BASIC with the BASIC used on the IBM System/34. That change delayed the DataMaster by nearly a year.

That experience taught us two things about getting a product to market rapidly: We needed to use an existing BASIC, and we needed to streamline the IBM development process. Applying what we learned was one of the reasons for the success of the IBM PC. We went to Microsoft for a BASIC interpreter. And we used our own fast-path development process, which included using executives to convince the rest of the corporation that we were on the right track.

The First View

Refinement of the original PC design swapped the positions of the power supply and the expansion cards, allowing the adapters to extend the full length of the box. That move put the power switch in the back corner—a long reach for users.

In the initial design, we included a pair of 5¼-inch floppy disk drives, a horizontal system board, and five expansion slots. Because of our experience with the DataMaster, we made the keyboard and display separate from the computer. The basic logic was to go on the system board, but expansion cards would give each system a unique flavor.

The width and depth of the box had to fit on a standard desktop and still leave room for the keyboard. After subtracting areas for the power supply and disk drives, the remaining space determined the size of the system board and expansion cards.

The initial system design was quite different from the device we finally announced. We shipped all systems with a minimum

continued

The one-piece DataMaster was a business-oriented single-user system. It served as a model for many of the features of the original IBM PC. ▶

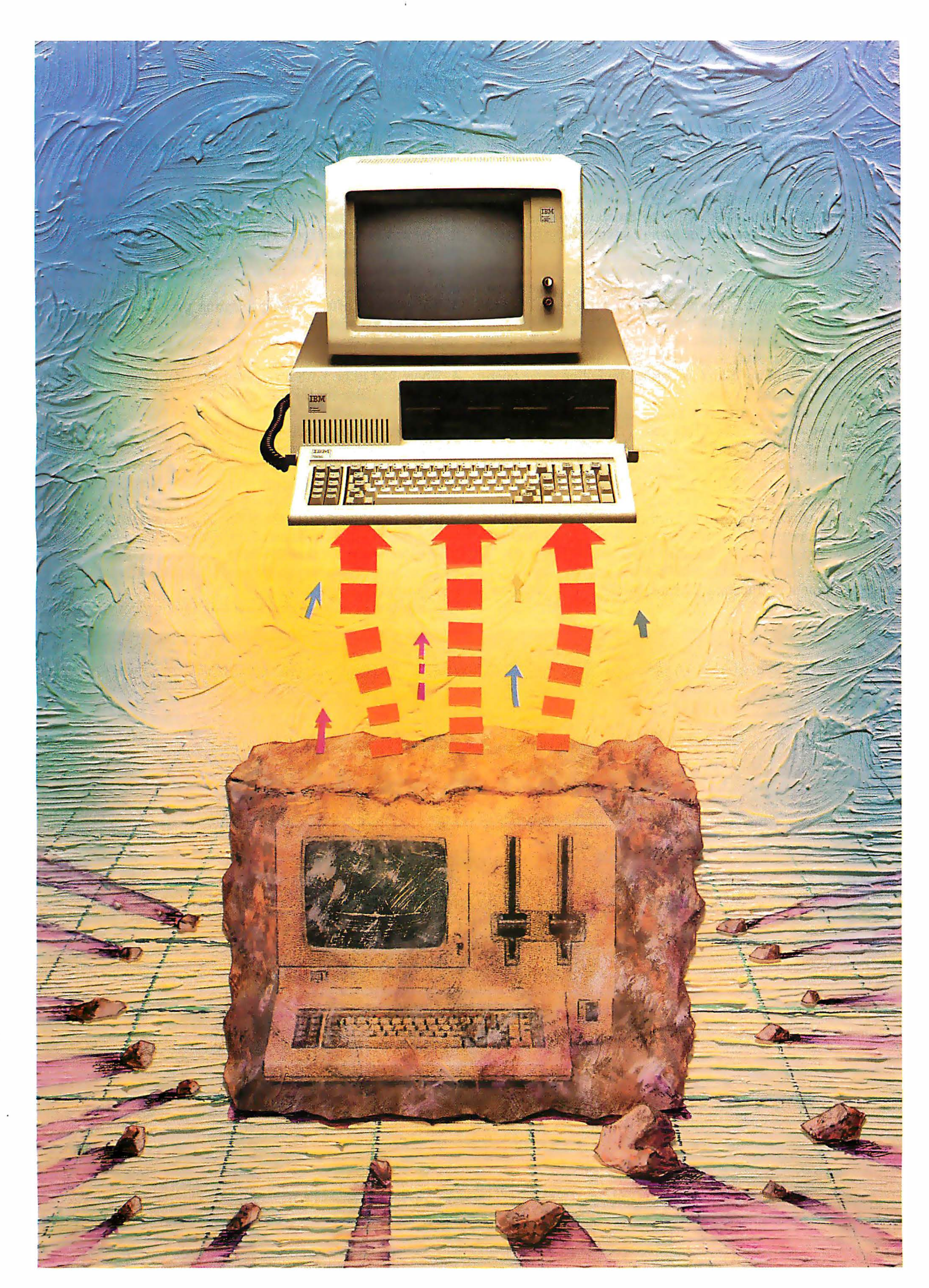


ILLUSTRATION: MASATO NISHIMURA © 1990

of 16K bytes of RAM on the system board. All systems had 40K bytes of ROM, which consisted of a 32K-byte BASIC interpreter and an 8K-byte BIOS. Our first design called for a total of five slots—exactly the same number that ended up in the finished product. We wound up actually developing most of the features on our original list, with the exception of the 8-inch disk drives; also, we changed the printer adapter to an industry-standard parallel port.

A major influence on the system design was the just-enacted FCC Class B requirement for electronic devices in the home. As the industry painfully learned in those early years, "hardening" the system to contain electromagnetic emissions was difficult, and sometimes more art than science. We designed the adapter-card brackets to fit securely in the enclosure to reduce the leakage. Many hours of testing, including some open-field work conducted in the Everglades (where bug removal took on a completely different meaning), were necessary to make the system pass the FCC criteria.

We had learned from the DataMaster development and from the experiences of others that even a company the size of IBM couldn't develop all the hardware and software to make a personal computer a success. From the beginning, we decided to publish data concerning all the hardware and software interfaces. Anyone designing an adapter or a program to run on the IBM PC would get as much information as we had available. A compilation of all the system specifications used during the system development and testing became the *Technical Reference Manual*.

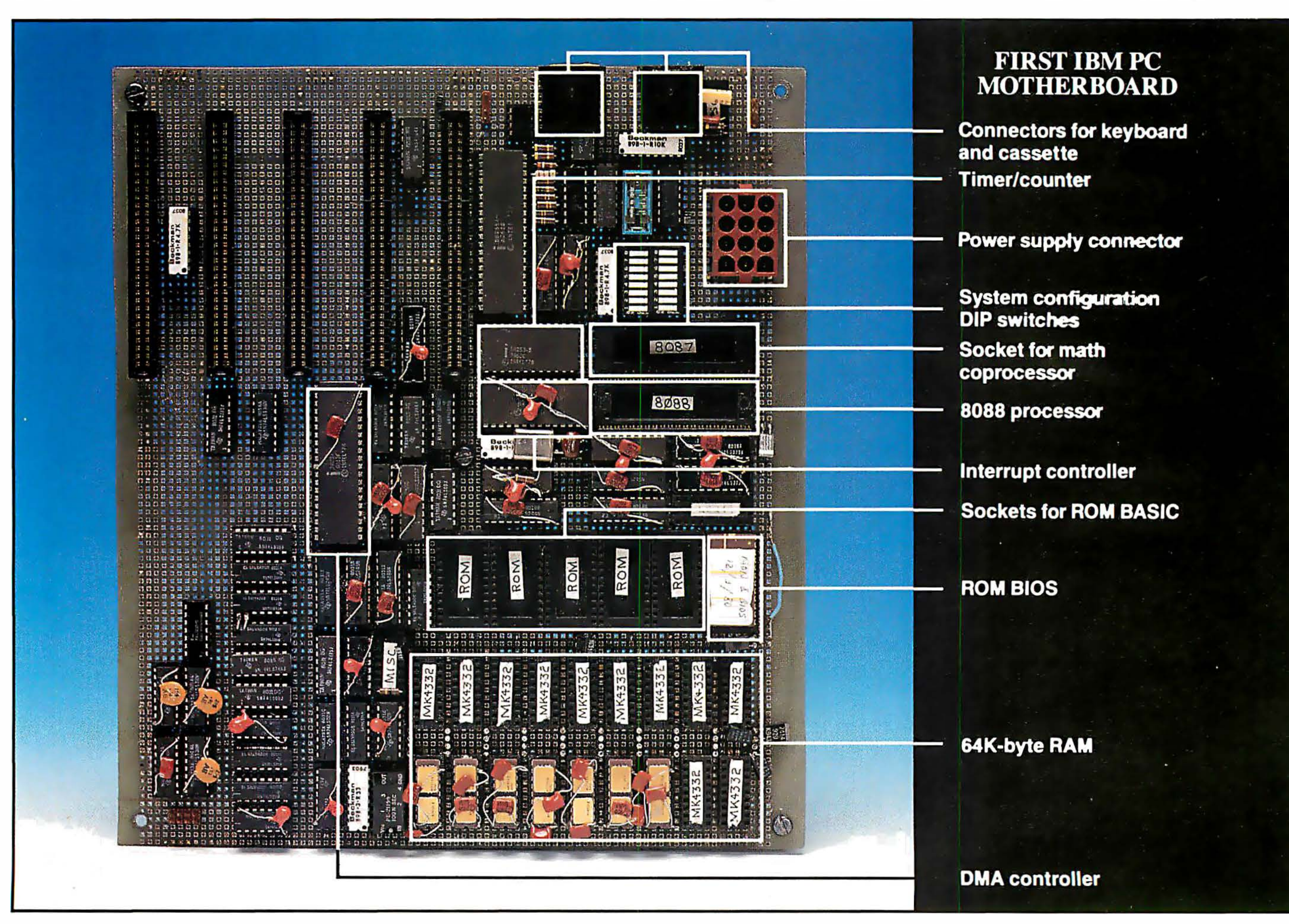
Why the 8088?

There were a number of reasons why we chose the Intel 8088 as the IBM PC's central processor.

1. The 64K-byte address limit had to be overcome. This requirement meant that we had to use a 16-bit microprocessor.
2. The processor and its peripherals had to be available immediately. There was no time for new LSI chip development, and manufacturing lead times meant that quantities had to be available right away.
3. We couldn't afford a long learning period; we had to use technology we were familiar with. And we needed a rich set of support chips—we wanted a system with a DMA controller, an interrupt controller, timers, and parallel ports.
4. There had to be both an operating system and applications software available for the processor.

We narrowed our decision down to the Intel 8086 or 8088. The Boca Raton engineers were familiar with these processors and their support chips. For programmers, the 8086/8088 architecture is a straightforward map from the 8080 architecture. The Microsoft BASIC group had already ported its BASIC interpreter from the 8080 to the 8086. There was also a DOS that ran on the 8086. Expansion of the address space was our primary goal. We chose the 8088 because of its 8-bit data bus. The smaller bus saved money in the areas of RAM, ROM, and logic for the simple system.

A bonus we got from choosing this Intel processor was the



numeric coprocessor. The 8087 gave the 8088 a fast partner for floating-point calculations. But since the 8087 wasn't yet available when the PC was announced, we simply left an empty socket on the board and didn't disclose a use for it.

16K Bytes and Up

The IBM PC was offered with 16K bytes of RAM, expandable to 64K bytes on the system board. We used 16K-bit DRAM chips because they were readily available. We built two memory-expansion cards, a 32K-byte and a 64K-byte card. With a fully populated system board and three 64K-byte cards, you could get up to 256K bytes of memory—at that time, an impressive amount for a personal computer.

We made one design choice that was unprecedented in a personal computer: to include parity on the memory. We thought it was very important to detect errors that might be caused by a failure in the memory and not allow the corrupted data to propagate further in the system. We believed it was better to halt the machine than to continue with errors. If an application program wished to change the way the parity error was handled, it could do so by simply changing the nonmaskable interrupt handler.

Why did DOS end up limited to 640K bytes? The answer is surprisingly simple. The 8088 has an address space of 1 megabyte. We reserved the upper 128K bytes for ROM on the system board. We wanted the video memory on the display adapters to be in the processor address space, so we reserved a 128K-byte section of memory for them. Finally, we reserved 128K bytes of memory for ROM or RAM on other adapter cards. At the time, we thought those allotments were generous.

When you subtract the reserved sections, the remainder is 640K bytes. Since the capacity of the original IBM PC was 256K bytes of RAM, and the norm for systems at that time was 64K bytes, we felt comfortable with the design. Although 640K bytes did become a limitation, so did the other reserved areas. I don't think there was a better way of arranging the memory that would have made a significant difference.

This wire-wrap board was the original planar built to prove the feasibility of the IBM PC design prior to laying out the printed circuit board. A similar one was built and shipped to Microsoft in December 1980 for development of the software. The photo at left shows the top of the board; the photo below shows the bottom.

Supporting the Processor

The support chips brought a lot of function to the IBM PC. DMA speeds up the I/O performance by relieving the processor of transferring the data between memory and I/O devices. We wanted the system to be able to perform multiple operations. A good example is allowing the user to type ahead on the keyboard while the disk transfers data. This feature enhanced the system's convenience and utility. We also used DMA for memory refresh, since it already had the control logic to request the bus and provide addresses to memory.

Being able to type ahead also requires keyboard interrupts. Using the eight-level interrupt controller relieved the processor from checking I/O operations continuously.

Even though the hardware and firmware shipped with the system didn't take full advantage of the DMA and interrupt capabilities, we included these functions for others. For example, the BIOS for the serial port didn't use the interrupt capabilities, but the serial communications built into Advanced BASIC did. Serial transmission and reception could take place under interrupt control while the BASIC program was executing.

The three-channel timer/counter let the IBM PC tell time, at least as long as the power was on. It was also the refresh timer and generated tones for the speaker. In addition, the counter could be used for many of the system's timing functions—for example, the code in the BIOS that read the cassette storage device. That code used the timer to determine the length of a bit cycle and decide whether a 1 or a 0 had been recorded.

Color and Text

We designed the IBM PC for two different roles: a business computer and a home computer. To support this versatility, we developed separate video adapters: CGA for the home and the Monochrome Display Adapter (MDA) for business.

MDA was based on the DataMaster display, which was monochrome and text-only. DataMaster used the Intel 827' CRT controller to generate the display. While the 8275 cut down on memory contention (by buffering each row of characters internal to the chip), it had two problems: It was limited to 7 bits for each character and so could display only 128 different characters, and it could set character attributes only by sacrificing a character position to the attribute specification. Thus, highlighting a word required a preceding and following attribute byte—one to turn on highlighting, and one to turn it off.

MDA has a single mode, 25 rows of 80 columns of text. We didn't use the DataMaster design because we preferred to do our own—using the Motorola 6845 for video timings—and put memory on the card for character and attribute storage. This design allowed us to have 256 characters, and we could specify the attributes for each character position. MDA was the first multifunction board developed for the IBM PC. It had a single parallel port to connect it to a printer.

For the IBM PC, we needed at least 256 characters to support the major languages, because the *I* in IBM stands for "international." Our experience with the DataMaster gave us a pretty good set to use. We also wanted "business graphics" in

continued

the character set (e.g., the lines and corners used to form boxes). We filled the remaining spaces with some word processing marks, Greek letters, and a few math symbols.

We wanted CGA to be able to work with a home TV as well as with a TV-frequency monitor. That criterion pretty much determined all the important things—like the number of dots on the screen. Two of the modes, 40- by 25-character text and 320- by 200-pixel all-points-addressable (APA), are constrained by the limits of a home TV. The remaining two modes, 80- by 25-character text and 640- by 200-pixel APA, require a monitor. The color capabilities were determined by the memory we could afford to put on the board—16K bytes of RAM. That amount of memory allows four colors for the medium-resolution APA and two colors for high resolution.

The organization of the memory, 16K bytes by 8 bits, gave rise to one of the problems of CGA: In 80-column text mode, the adapter had to fetch 160 bytes per line—80 characters and 80 attributes—leaving no time for the processor to read from or write to the display. Any program that went directly to the display memory quickly filled the screen with "snow." The read and write routines in the BIOS waited for horizontal retrace before accessing the memory. The scroll routine in the BIOS, which had to move lots of data, simply turned off the display, did the move, and then turned the display back on. There was a noticeable blink as the screen scrolled, but it was less objectionable than the blizzard that would have occurred otherwise.

Cassettes, Then Diskettes

Because we planned on people using the IBM PC at home, we included a port so a cassette could be used as a storage device. The system was available with no disk drives, 16K bytes of RAM, and Cassette BASIC in ROM. With this configuration, you could load and execute BASIC programs from a standard audiocassette tape player. We did optimize the system design for business use, though, with bays for two floppy disk drives and 64K bytes of RAM on the planar.

Disk-based systems far outsold those without, and just about everyone who bought a cassette system eventually upgraded to disks. Although the cassette port was retained on the PC for compatibility, we removed it from the XT when that was designed.

Bus Architecture: DataMaster Descendent

The IBM PC's bus architecture came from two sources: the DataMaster definition and the new requirements of the 8088. We wanted to keep the bus very similar to the DataMaster's, since we had developed several adapter cards for that bus. Keeping the bus similar would make the adaptation very simple—just a new layout of the cards.

The 62-pin connector also came from the DataMaster. The extensions for the 8088 were obvious—a few extra address lines. The DataMaster used the same interrupt controller and a similar DMA controller, so those signals were already on the DataMaster bus. The final definition changed only five of the originally proposed signal lines.

One thing we didn't foresee when we defined the system bus was the proliferation of adapter cards for the PC. Although the variety turned out to be a good thing because it gave customers a wide choice of options, we hadn't allowed enough I/O addresses for all the cards that eventually were developed.

Original expansion cards decoded only a 10-bit address, and many cards used 8 or 16 addresses. Consequently, almost every card ended up with a set of switches to select the I/O address it would respond to and the interrupt line it would use in a

continued

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given system. While the DIP switches were workable, they required the user to review all the documentation every time another card had to be installed. The answer was a programmable method of device selection, which was one of the reasons for the change to the Micro Channel architecture in the PS/2 family.

Keyboard Control

The IBM PC keyboard came from the DataMaster. We changed the key tops to reflect the general-purpose nature of the PC, replacing labels such as HELP with F4. Since the DataMaster keyboard was inside the system box, it used a parallel connection to the system board. For the IBM PC, we made the keyboard separate and connected it to the system via a serial port and a 6-foot coiled cable.

One of the questions often asked about the IBM PC is why we chose the Ctrl-Alt-Del reset sequence. We proposed Ctrl-Alt-Del as a warm-boot sequence to provide some of the capability of a reset switch. It is difficult to activate by mistake, since the keys are widely separated. By storing a special character in a particular memory location, the warm boot would bypass the memory-test portion of the power-on self test (POST), taking less time than turning the machine off and back on.

The difficulty with Ctrl-Alt-Del, however, is that for the reset to work, the system must be capable of receiving input. If the program has gone completely off into the weeds and has disabled the interrupts, the reset won't work. But production software should not exhibit this kind of behavior.

There were two other concerns with the original keyboard: the placement of the Left Shift and Enter keys, and the lack of indicators for Caps Lock, Num Lock, and Scroll Lock. The keys ended up as they did because we wanted to support the international keyboard, which has several additional keys. We improved the layout with the IBM AT keyboard. That keyboard also had the indicator lights for the shift states.

Firmware and Diagnostics

We intended for the PC's BIOS to serve as a buffer between the hardware and a programmer. Some of the things it handles (e.g., sending a character to the printer) are very simple. Other operations (e.g., decoding the scan codes from the keyboard into the desired characters) are very complex. We wanted a programmer to be free to concentrate on the problem, not the hardware.

Another important part of the IBM PC was its diagnostic strategy. The POST annoyed some users because the system came to life slowly. But we thought it was important to test the system before turning it over to an application, reasoning that it was better to find a hardware problem before it caused a mistake in your data.

Industry Revolution

When we first began development of the IBM PC, we didn't appreciate the potential of the product. The company originally estimated it would market a total of about 250,000 units over a five-year period. As it turned out, there were some *months* when we built and sold nearly that many systems.

IBM has since delivered millions of PCs to the marketplace. The sales estimates may have been faulty, but the product certainly wasn't. I'm very happy to have been a part of it. ■

David J. Bradley is the manager of Advanced Processor Design, Entry Systems Division, at IBM (Boca Raton, FL). He was a member of the original team that designed the IBM PC and has a Ph.D. in electrical engineering. He can be reached on BIX c/o "editors."

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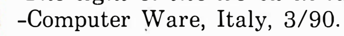
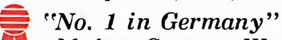
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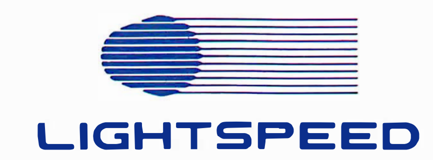
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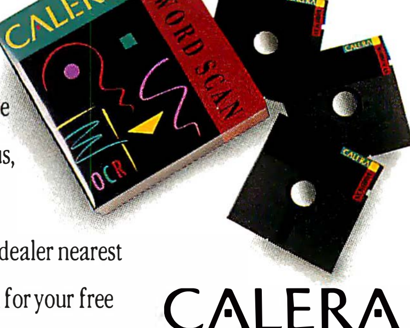
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Circle 56 on Reader Service Card

FROM A TINY KERNEL...

Getting from OS-9 to OS-9000 involved more than adding three zeroes

Ben Smith



From looking at it, it would be difficult to imagine the tiny Tandy Color Computer as a multitasking powerhouse. With OS-9, however, it can be, and the lessons learned in designing that microkernel operating system have blossomed into commercial-quality software for 386- and Motorola 680x0–based computers.

In 1980, Microware Systems developed OS-9, a multiuser, multitasking operating system for the underrated Motorola 6809 (the processor in the Color Computer). By 1983, the usefulness of the small kernel and modular design had attracted enough serious industrial users that Microware had ported its operating system to the 16-/32-bit Motorola processors. With the popularity of the Motorola VMEbus boards for use in industrial controls, OS-9 became more than an occasional operating system for commercial applications. You can still buy OS-9 (for under $100) for the Tandy Color Computer, but you can also find it on just about any Motorola-based personal computer, as well as the industrial VME boards. It's also easier to spot in Europe and Japan, areas where OS-9 is more commonly used than in the U.S. It must have something going for it if it is used so widely.

A Quick Look at OS-9

OS-9 has a compact kernel around which you link only the modules you need. Device drivers (and other modules) can be added anytime, without relinking the kernel. Writing device drivers for OS-9 is easy compared to doing so for Unix System V release 2 and lower. Also, OS-9 is fast; it was designed to take full advantage of the capabilities of the Motorola processors. Although the original version of OS-9 was a little ragged and lacked many of the amenities of other operating systems, it has grown to be a rich environment with no significant bugs.

To the user, OS-9 is somewhat like Unix. It has a shell and a scripting language akin to the Bourne shell. Files are arranged in a tree structure, with separate user areas. File access is granted by permission to read, write, and execute for owner, group, and world. Everything, including devices, is treated as a file. Most utilities have Unix counterparts that behave in much the same way.

The latest release from Microware is so much of an advance that it is no longer called OS-9. Now we have . . .

The Birth of OS-9000

Of course, Motorola is not the only popular manufacturer of high-performance microprocessors. Intel seems to be doing pretty well with the 386—so well, in fact, that 386 systems are inexpensive and widely available. Microware thought that it should offer its real-time operating system to the industrial developers who want to save some money and use the Intel-based PC systems. Hence, OS-9000, a total rewrite of OS-9, was born.

OS-9000 looks pretty much the same as OS-9 to the programmer and user, but now it is written in C (rather than assembly language) for portability. Even at the onset, OS-9000 was available for the Motorola 68020, 68030, and (theoretically) 68040, as well as the Intel 386 and i486.

Even though this is a completely new operating system, it is more stable than most such first attempts. Microware cut its teeth on OS-9, and the effort paid off. But it is a young operating system, and many popular utilities still haven't been brought over from OS-9. Actually, many of the utilities come from the free source code that is available in the Unix community (see The Unix /bin, June, July, and August BYTE). Enough of OS-9000 is conceptually like Unix that porting from Unix to OS-9000 is far easier than porting from Unix to DOS or OS/2.

The OS-9000 development tools are necessarily like their Unix counterparts. Cross-development is not only possible, but encouraged. And Unix isn't the only route to OS-9000; you can also port applications from DOS and OS/2. The idea is that you should be able to develop on any of these other operating systems, using your favorite development tools, and end up with a multitasking, real-time application for your OS-9000 system.

continued

ITEMS DISCUSSED

OS-9000 (386 version) $995
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The networking tools make it a simple BNC twist to extend it out to these other systems.

Of course, there are fine tools on the native system, including a clean version of MicroEMACS, the Unix `make` project management and file dependency program, and extensive function libraries, including ANSI C, Unix, and real-time programming functions. It also includes a fine source code debugger, and a flexible and efficient C compiler and assembler.

Journey to the Kernel and Beyond

OS-9000 is not really unique in basic design (see Part 1 in this series, "The QNX Operating System," August BYTE). It has a small, fast kernel. The concept of a memory module is central to the design. Memory modules are not limited to executable code, but can also be used for data. In fact, you can design your own module type as long as you follow a few rules of construction. All modules share the same memory map, which is managed by the kernel.

Although access to modules can be controlled in the same way as access to files, any module can generally access any other module. This means different processes can easily share the same data modules. With freedom comes responsibility, and it is the programmer's responsibility to share modules in an intelligent way. The operating system doesn't have enforced layers of memory management. But the programmer is not without the tools: OS-9000 has pipes, named pipes, signals, and semaphores, as well as "events," so different processes can communicate and synchronize their use of the resources.

These tools are called *interprocess communication* mechanisms. Unix developers are familiar with pipes and named pipes, the first-in/first-out methods of IPC. Unix also uses signals to notify one process of independent or special conditions that might need urgent attention. Semaphores are a traditional way for different processes to set and respond to shared flags. The OS-9000 event IPC is like a semaphore, but it is much more sophisticated. Among the many elements in its structure, it has a name, an owner, and a 32-bit value that can be set to any value and incremented. There are nearly two dozen function calls available for creating, linking, signaling, reading, waiting on, and deleting events. Events are used primarily to synchronize concurrent processes that are sharing resources.

All running processes and their associated modules are in memory at the same time. If you want more processes, you add more real memory. But there are system calls and utilities you can use to load and unload modules as you require. Only by keeping everything in real memory, in a constant position, can the operating system make things happen at a predictable time, the tenet of real-time computing.

How Real-Time Can You Get?

OS-9000 on a 386 machine gives you a real-time resolution of $\frac{1}{100}$ second. You can be assured that any event will happen within $\frac{1}{50}$ second. This is more than fine enough to control many industrial processes directly. This fineness of response time is

continued



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a function of the operating system, not some special hardware. Standard Unix, with its kernel-bound I/O and virtual memory, gives you no guarantees as to when an event will occur.

If you want to control devices with millisecond and microsecond precision, you don't do that directly from an operating system. Instead, you use a dedicated processor to control the device, and it communicates with the operating system.

You probably won't be using OS-9000 for your common PC applications, but you would for solving special industrial problems. If you have a high-speed production printing machine, it may be using OS-9000 to control the electron guns to cure the ink. One OS-9000 licensee uses it for remote data collection on relative aircraft and target positions while simultaneously controlling tracking radar and cameras. OS-9000 may have been on the computer at a highway tollbooth that counted your change and raised the barrier. The machinery that manufactures and bonds the plastic film that covers your flooring may have been controlled by an OS-9000 machine. These are applications for a real-time, multitasking operating system.

The value of OS-9000 and similar operating systems lies in more than just the fineness of response time. The completeness of the tool set is just as important. There are many system calls for communication with external events as well as for IPC. This is a controlling operating system; to do its job well, it needs to communicate well.

For Whom and Why

You can use OS-9000 anywhere you want a multiuser, multitasking operating system. It has the basic tools and design features for any kind of application. It is particularly well suited for system houses that focus on data acquisition and control of specialized equipment. In this role, it can handle much of the control as well as the human interface. Because of its standard implementation of common networking facilities (TCP/IP and NFS), it is well suited to handle just the control end, leaving the human interface to another operating system.

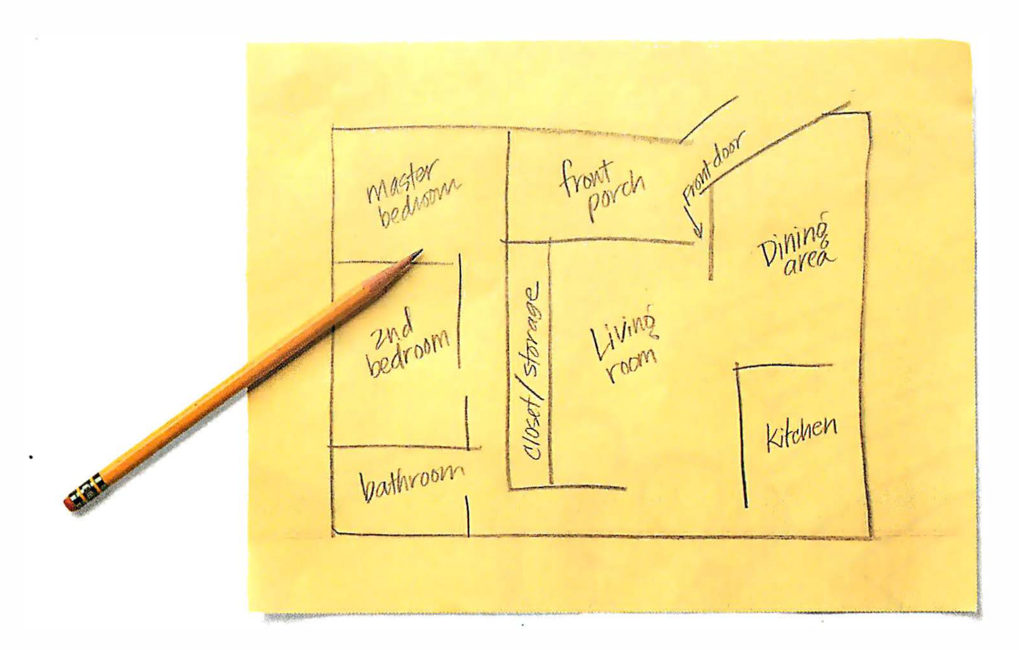
To make the most of the libraries and utilities, you should be well grounded in your understanding of the hardware you will be working with and in general concepts of device drivers. Everything is oriented toward the developer who wants to have the responsibility of tight control over the system.

OS-9000 does not use any of those fashionable abstractions that you find in Mach and QNX. There are no "threads" and "messages in the mailbox." As a developer, you find yourself doing bit shifts and masks. Even though the abstractions of some of those other, small-kernel operating systems make it easy to use them in multiprocessor and distributed computing environments, a performance and code-size price is paid. OS-9000 is valuable to the developer of both Motorola- and Intel-based systems. This is a unique claim for a real-time operating system.

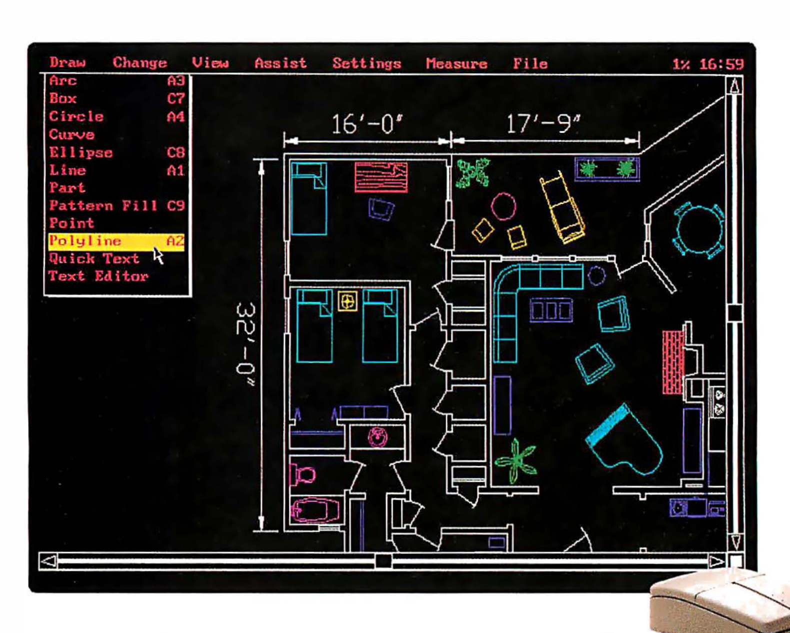
OS-9000 has more than just history going for it. It places a lot of power in the hands of the programmer, but be prepared for the responsibility that accompanies it. If a task *must* be done in real time, OS-9000 can do it, but you must learn to speak to the operating system on its own level. While it lacks the high-level abstractions of more popular commercial operating systems, it delivers on the promise of split-second attention to events and devices. As an operating system, OS-9000 deserves to be judged on its own. ■

Editor's note: *Next month, BYTE's Tom Yager looks at Theos.*

Ben Smith is a technical editor for BYTE. He can be reached on BIX as "bensmith."



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SOUNDS OF SUCCESS

Professional sound capabilities, once the exclusive domain of high-end recording studios, are now available to PC users

Dean Friedman

Over the past few years, the advances in microcomputer graphics have been obvious to even the most casual observer: Higher-resolution images, full-motion digital video, and state-of-the-art animations can be seen in everything from business presentations and logos on the evening news to multimedia extravaganzas.

But what of the sounds that accompany those images? Are we stuck with the pitiful beeps and buzzes of the early microcomputer days? Hardly. Thanks to the advent of hardware and software that rival those of the computer graphics explosion, producers of audio/video presentations—everything from computerized slide shows to scores for motion pictures—can have professional sound capabilities available right on their desktops (see the figure).

MIDI Made the Difference

The merging of music and microcomputers began innocently with the establishment of MIDI, the industry standard for music synthesizers. MIDI is a protocol for sending digital information over serial lines between electronic musical instruments and equipment, including computers. The information includes note on and note off, key velocity (speed of keystroke), aftertouch (pressure applied after keystroke), pitch bend, modulation wheel, foot pedal, and sound changes. With MIDI, a musician can play a single keyboard and simultaneously trigger a roomful of synthesizers. MIDI guitars, MIDI woodwind instruments, and even MIDI acoustic voice trackers are also used to control the array of equipment.

MIDI's potential became obvious when programmers began writing applications that took advantage of its ability to interface synthesizers directly with personal computers. The first and most important of these applications was the music sequencer. Today, there are six categories of music software:

- Sequencers
- Editors/librarians
- Notation programs
- Pattern generators
- Film score utilities
- Everything else (for lack of a better term)

The Sequence of Things

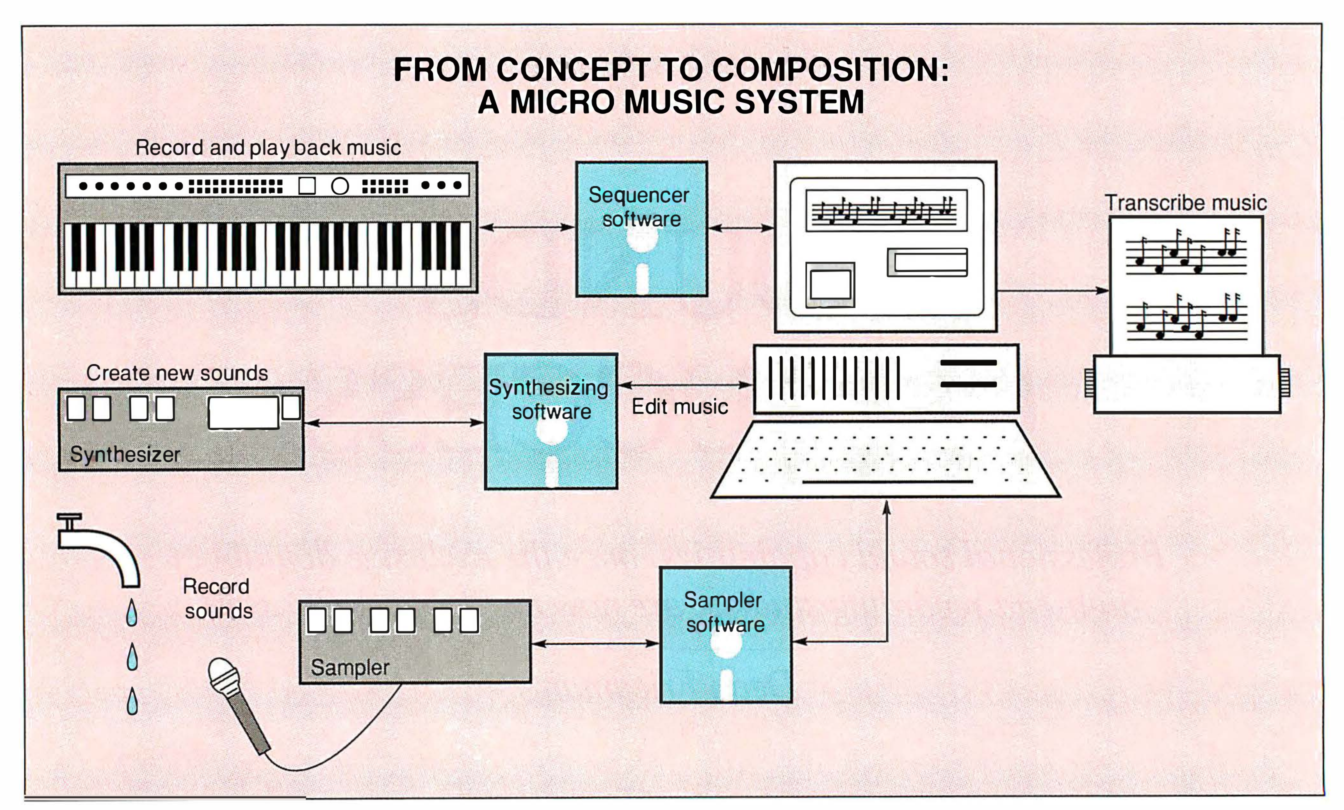
In computer music parlance, a sequencer is a program that records the events and gestures of a musical performance. The electronic equivalent of a player piano roll, music sequencers record the events of a musical performance—but not the actual sounds. The sequencer can play back the instructions to the appropriate synthesizer or sound module, telling it exactly when to trigger its sounds.

Unlike tape, the audio playback from a sequencer never degrades in quality caused by generations of overdubs or by tape wear. The playback from a sequencer is always first-generation. Unlike tape, a sequenced performance can be sped up or slowed down without transposing the music's pitch, and, conversely, a sequenced performance can be transposed without altering its tempo. With analog tape, pitch and tempo are permanently intertwined; changing tempo automatically changes pitch, and vice versa.

One other fundamental difference between a sequencer and tape (analog or digital) is that, while tape permanently records all the elements of a performance, including the sound that was actually made during the performance, a sequencer only records the skeletal outlines of a musical performance; that is, the timings, durations, and numeric values of the keys that were played. With this information, a musician can experiment with different sounds in the same musical piece, auditioning a variety of timbres until he or she finds the one that works best.

The sequencer didn't replace multitrack analog or digital recording formats. Those are still necessary for handling acoustic instruments like voice and guitar, and for mixing down to a final two-track master audio format. But the sequencer allows anyone with a personal computer and a few synthesizers to

continued



The versatility of the personal computer and its graphics screen make it an ideal front end for any electronic music system. Software that performs sequencing, synthesis, sampling, and notation have made it possible to have an entire studio in a box.

prepare, and in some cases even master, a finished album in his or her own virtual studio.

This basic concept spawned a musical revolution. It had the effect of turning the recording industry on its head. In the process, it created a billion-dollar-a-year market for MIDI devices and peripherals. Suddenly, a new world of polyphonic (more than one note), multitimbral (more than one sound), multitrack, digital music systems became available to anyone who could cough up the price of a cheap PC clone (or an even less-expensive Commodore 64) and a few synthesizers.

Recordings that previously would have cost upwards of $100,000 are now made for only a few thousand dollars, and even less as MIDI software and hardware evolve.

Dedicated music sequencers had existed prior to MIDI, but it was only when the power of a microcomputer with graphics was added to the MIDI network that sequencing packages flourished into elegant and intuitive music-making programs.

Sequencing Software

Although the basic job of sequencers remains the same, the extra features in today's computer-based sequencers bring joy to the work of making music. Four of the five main personal computer platforms have high-end professional music sequencers: the Amiga, Macintosh, Atari ST, and IBM PC. The fifth platform, the NeXT machine, has the best standard hardware with its compact-disk-quality audio, but it suffers from a dearth of commercial music software.

The list of top-notch, high-end professional music sequencing software packages includes Vision by Opcode, Performer by Mark of the Unicorn, Cubase and Pro 24 by Steinberg/Jones, Master Tracks Pro by Passport, Beyond and KCS by Dr. T, Sequencer Plus by Voyetra Technologies, Personal Composer by a company of the same name, and Cakewalk by Twelve Tone Systems. Used regularly in recording studios around the world, they all provide the means to do graphics editing, since your music sequence is depicted graphically, either in standard musical notation or as rectangles on a pitch/time grid.

The graphics editing tools include the same kinds of cut-and-paste, copy, insert, and delete commands that you'd find on any word processor. The analogy is a good one: Music sequencers let you manipulate and manage music in much the same way a word processor lets you move and manipulate text.

Today's sequencers also offer graphics tools for editing other MIDI parameters, such as aftertouch, key velocity, pitch bend, and modulation wheel moves, as well as a host of continuous and intermittent controller messages. Controller messages include additional and often simultaneous performance parameters such as volume-pedal changes, sustain-pedal events, and patch or sound changes.

In a program like Vision, for example, a pitch-bend movement can be graphically edited by simply drawing or reshaping a curve under the affected note or notes. This type of graphics controller editing represents a vast improvement over the first generation of sequencers, in which the musician had to edit a list of hundreds of numbers.

One of the newest implementations of graphics controller editing is *automated fader mixing*. This feature displays a row of 16 or 32 mixing faders, which the musician can assign to control any of the common MIDI continuous controller parameters (e.g., volume pedal and modulation wheel), as well as additional internal sequencer parameters (e.g., tempo). As an illustration, if the musician assigns faders to the volume levels of all his or her MIDI instruments and then records the sequence

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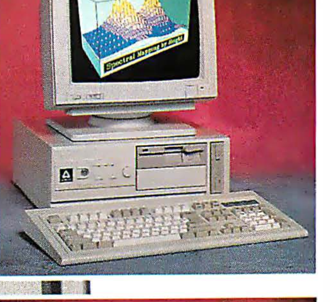
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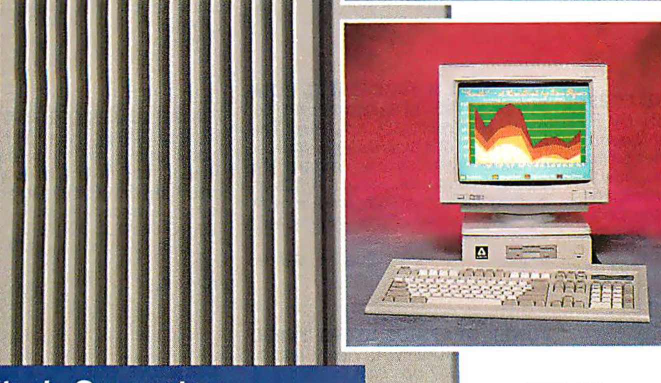
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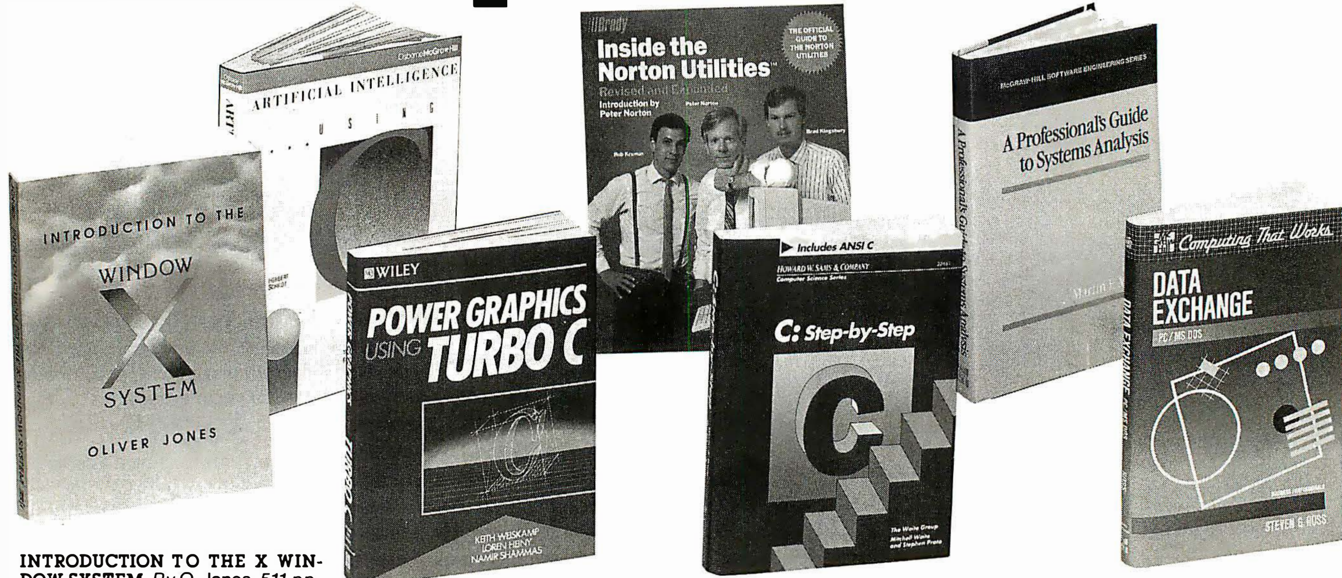


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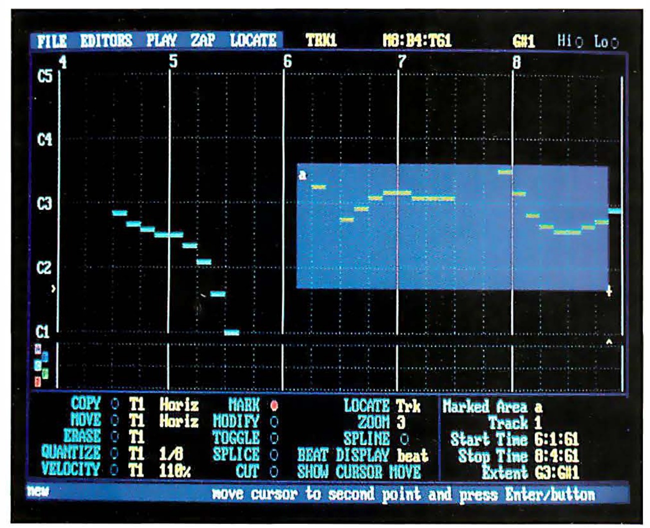
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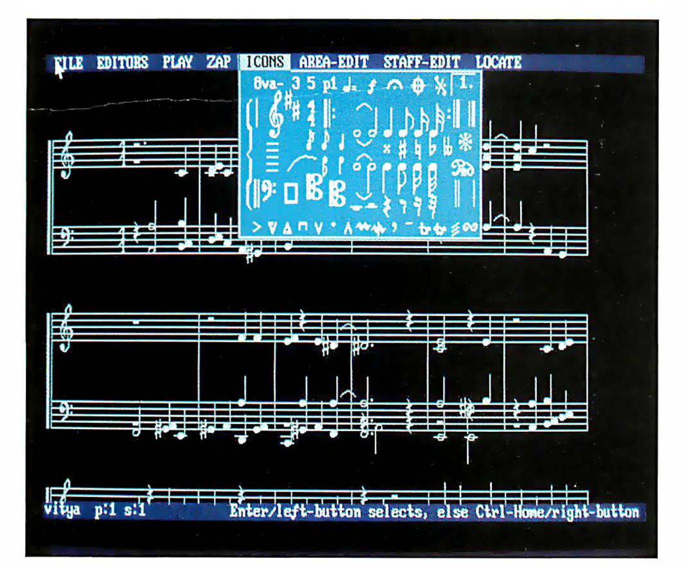


Photo 1: *Personal Composer is the first PC-based music workstation program. It combines a 32-track MIDI recorder/sequencer* **(top)** *with an event editor* **(middle)** *and a score editor* **(bottom)**. *Each part of the program affects the other so that a musician can start with either of the editors or the recorder and end up with both a publishable score and the MIDI sequences that perform it. Since Personal Composer is Lisp-based, it is fully extensible.*

of individual fader moves, he or she can program the volume mix as part of the sequencer. The automated mix will keep all relative volume levels in balance throughout a dynamic piece.

Libraries of Sound

Synthesizers and samplers (a close relative) store the instructions used to create a sound in memory. These instructions are called patches or programs. They contain the voice settings that define each individually stored sound. With the pitifully small display on most keyboards and sound modules—30 to 80 characters—it is very difficult for the musician to edit or design a sound. A typical synthesized sound may have as many as a hundred different variables to describe its harmonic content, filter and amplitude envelopes, pitch, volume, and so on. It's hard enough to be aware of all the relationships of these variables. It is extremely difficult if you can't see the values all at once.

Voice-editing software displays all of a synthesizer's internal voice parameters simultaneously on a single monitor. What's more, editors can depict complex voice parameters graphically far better than the built-in LCDs of the synthesizer. It's far easier to understand an envelope when you can see its shape than when all you see is a list of numbers.

Some voice editors use the computing power of the computer to manipulate voicing parameters in ways the synthesizer can't. For example, a random-voice-generator option can produce variations on a sound by manipulating the parameters automatically within a specified range.

Once sounds are defined, you can store them using a companion to the voice editor, known as a librarian. This utility is simply a database for storing and retrieving patches or sounds. Many synthesizers can store no more than 100 different sounds internally, but a computer with a librarian can store thousands of patches on a single disk. You can also sort, search, copy, and delete patches.

In the past, owing to the unique architecture of each synthesizer, editors/librarians were instrument-specific. Every time a new synthesizer was released, software houses scrambled to be the first to sell software for it. The recent trend is toward developing more generic editors/librarians. Such programs either come bundled with multiple editors or include a MIDI toolkit that you can use to design your own editor or librarian templates. Some examples are MIDI Quest by Sound Quest, GenEdit by Hybrid Arts, X-or by Dr. T, Master by CMS, Galaxy by Opcode, and Super Librarian by Pixel Publishing.

The Final Score

Since the first hint of MIDI's phenomenal success, electronic musicians have fantasized about being able to sit down at a keyboard, play a performance, and instantly print out a music manuscript in perfect standard musical notation. Easier said than done. It's easy enough to teach the computer to recognize pitch, time, duration, and other objective values. But such decisions as how measures should be divided, where bar lines should go, which notes should be beamed together, and what kinds of expression markings are needed are all subjective. Such decisions are generally too daunting for the computer to make on its own. Therefore, some editing is usually necessary before a manuscript can be considered complete. It's this post-input step that has given notation packages a reputation for being a real bear to learn.

Some notation programs require input in the form of sequencer files, rather than using live keyboard input. The notation package needs to compile these files before it can produce the music notation. Some of the notation packages have you

continued

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perform your music directly into the program, and then, after a brief compilation period, they display it in notated form. Several notation programs (e.g., C-Lab's Notator, and Coda's MusicProse and Finale) can actually display your performance in notated form as you perform it.

There are some combination sequencer/notation packages on the market. Personal Composer (see photo 1) was the first successful sequencer for the PC, and it has always offered notation as an integral part of its package. Notator and Mark of the Unicorn's Performer 3.4 have fluid, high-end sequencers that can display notation in real time.

The problem with some of the most powerful notation packages is that they are painfully difficult to learn. A professional notation package like Finale is one of the most feature-packed notation packages on the market, but it might take an experienced computer musician up to three months to become proficient. For some users, this learning curve can be justified in view of its enormous power and flexibility.

Fortunately for those of us who barely take time to read the introduction to the manual, the newer notation packages are designed with friendlier and more considerate user interfaces. MusicProse provides a simpler user interface than its predecessor but has less powerful features.

Releasing scaled-down versions of complex programs is becoming something of a fashion in music software applications. While offering reduced features, these versions maintain file compatibility with their more powerful counterparts, but they have a much flatter learning curve. Some examples are EasyVision, Opcode's introductory version of Vision; Easy Performer, Mark of the Unicorn's introductory version of Performer; and Tiger Cub, Dr. T's introductory version of Beyond.

One drawback of composing with computers is that there is no way to derive inspiration by bouncing musical ideas off other musicians. A slew of music applications referred to as Random Pattern Generators and Compositional Aids respond to this shortcoming. While they don't necessarily replace a live musician, random pattern generators do succeed in turning the personal computer into a contributing partner in composing and performing. These applications apply random pattern algorithms to thematic source material. This source material is altered according to parameters established by the composer. Being able to apply the randomizing power of the computer within defined musical limits enables a composer to creatively generate new textures and forms within a theme. In the hands of a musician, this powerful tool can yield impressive results that would not have developed by more conventional means.

Some good programs are Sybil by Scorpion Systems; Jambox, Upbeat, and M by Intelligent Music; Sound Globs by Twelve Tone Systems; and MIDI Mouse by Dr. T. Sybil is unique in that it offers dynamic real-time performance features. M is one of the finest examples of an interactive pattern generator. It has an appealing and intuitive user interface for modifying musical material.

Some recent sequencer programs have random pattern generators, although they tend to be less powerful than the stand-alone packages. A standout is the creatively designed music sequencer called Bars & Pipes by Blue Ribbon Bakery. It has a number of built-in randomizing tools, as well as the means to create your own pattern-generating tools from scratch.

In Sync

To score soundtracks to film and video, it is critical to accurately lock a sequencer's timing onto the pulse of an audio- or videotape machine or another sequencer. Early sequencers

continued

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Photo 2: *A synthesizer and software, such as Dr. T's MT-32 Editor/Librarian (shown here), allow you to create entirely new sounds that can then be used in musical compositions.*

accomplished this by locking onto an analog pulse on one of the tracks of the tape, a method known as FSK (Frequency Shifted Keying). It worked well but was prone to dropping out of sync, and it required that both the sequencer and the tape machine always started from the beginning of a performance.

Today, the preferred method of synchronization is via SMPTE (Society of Motion Picture and Television Engineers) coding. As is obvious from the name, this is the time code standard used in TV and film. It specifies time in frames per second. Most current sequencers address SMPTE time code either directly or indirectly via another standard, MIDI time code, that divides time into beats per quarter note.

The synchronous lock-on is achieved with an SMPTE-to-MIDI converter, which translates the musical timing divisions of MIDI time code into the video- or film-frame realm of SMPTE. Synchronization is accurate to the resolution of a frame. It can begin anywhere instead of requiring a simultaneous start from the beginning of a piece.

All high-end music sequencers have this important synchronizing ability, but sequencers alone don't address *all* the specialized, complex needs of a musician who is adding sound to visuals. As a result, a new category of music software known as cueing software has quickly evolved. These programs are designed to work hand-in-hand with a music sequencer to automate as much of the scoring process as possible.

Opcode's Cue, Passport's Clicktracks, and Dr. T's Hitman all share the following features:

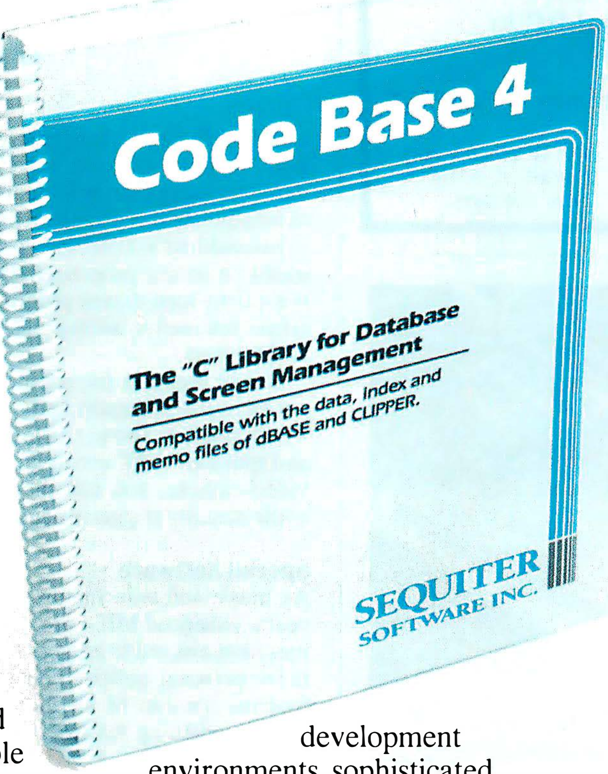
- They provide a fast and easy way to identify and tag the beginnings and ends of cues in a film (i.e., the points in a film that require music).
- They help calculate optimum tempos, enabling the composer to catch the maximum number of hits (synchronized musical/video events) during a cue.
- They can perform instantaneous time-format conversions, allowing you to translate a single cue point into NTSC or PAL video frames, film frames, or beats per minute.

Some of these programs have limited sequencing features themselves, allowing you to trigger single MIDI events or even

continued

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complete sequences created in a dedicated sequencer. All the features help enormously in minimizing the most tedious and time-consuming aspects of soundtrack composing, leaving the composer more time to actually compose music.

Multimedia Masters

There are some powerful software packages that allow you to integrate audio and MIDI note events with video, graphics, and animation—in other words, multimedia. One of the most prominent of these is Commodore's AmigaVision, the multimedia icon-based authoring system that is being bundled with the new Amiga 3000. Another is Showmaker by Gold Disk, a time-line-based multimedia sequencer geared toward video production. Both of these products make full use of the Amiga's native multitasking operating system and offer features that allow you to manipulate musical elements within a multimedia event.

The next music software evolution is just now getting off the ground.

MacroMind's Director is designed specifically for multimedia. A unique program from HIP Software, called HookUp, is a quirky icon-driven programming toolkit that allows you to create interactive animations that trigger or are triggered by MIDI events.

One of the most interesting and unusual programs to incorporate music in a multimedia environment is Mandala by Very Vivid. It allows you to employ video input to control animations and musical MIDI events in real time. Standing in front of a video camera, you can play virtual instruments in thin air while actually triggering audio samples.

Special Software

As music software matures and moves beyond its formative years, enhanced MIDI protocols and a collection of MIDI utilities have evolved to address the needs of music and MIDI within the personal computer environment. MIDIBASIC by Altech Systems consists of 12 additional MIDI-related BASIC commands, enabling BASIC programmers to more easily create music applications. A MIDI utility by Bartleby Software called Monitor allows you to examine, send, and store MIDI data as hexadecimal, decimal, or binary numbers, or as text.

With the proliferation of voice editors that provide features for conventional synthesizers, it wasn't long before developers exploited the audio circuitry in computers themselves. Synthia by The Other Guys uses the four-channel digital-audio hardware of the Amiga. It is essentially a synthesizer/sampler on a disk. New Wave Software's Dynamic Drums turns the Amiga into a polyphonic drum machine. Drummer by Cool Shoes turns the PC into the front end of a drum machine, triggering (via MIDI) any remote drum module or synthesizer.

The New Music

Exotic random pattern generators and new MIDI utilities will continue to come our way in varying forms, and the necessity of

continued

ITEMS DISCUSSED

Here is the contact information for all the products mentioned in this article. The superscripts refer to the machines that each product runs on: the Amiga (Am), the Atari ST (At), the IBM PC (PC), the Macintosh (M), and the Apple IIGS (GS).

AmigaVision[Am]
Commodore Business Machines
1200 Wilson Dr.
West Chester, PA 19380
(215) 431-9100
Inquiry 1052.

Bars & Pipes[Am]
Blue Ribbon Bakery
1248 Clairmont Rd.
Atlanta, GA 30030
(404) 377-1514
Inquiry 1053.

Beyond[Am,At,M,PC]
Hitman[At]
KCS[Am,At,M,PC]
MIDI Mouse[Am,M]
MT-32 Editor/Librarian[At,PC]
Tiger Cub[Am,At,M,PC]
X-or[At,PC]
Dr. T
220 Boylston St.
Chestnut Hill, MA 02167
(617) 244-6954
Inquiry 1063.

Cakewalk[PC]
Sound Globs[PC]
Twelve Tone Systems
165 Bedford St.
Burlington, MA 01803
(617) 273-4437
Inquiry 1054.

Clicktracks[M]
Master Tracks Pro[Am,GS,M,PC]
Passport
65 Miramontos St.
Half Moon Bay, CA 94019
(415) 726-0280
Inquiry 1055.

Cue[M]
EasyVision[M]
Galaxy[M]
Vision[M]
Opcode
3641 Haven Dr., Suite A
Menlo Park, CA 94025
(415) 369-8131
Inquiry 1056.

Cubase[Am,At]
Pro 24[Am,At]
Steinberg/Jones
17700 Raymer St., Suite 1001
Northridge, CA 91325
(818) 993-4091
Inquiry 1057.

Director[M]
MacroMind
410 Townsend St., Suite 408
San Francisco, CA 94107
(415) 442-0200
Inquiry 1058.

Drummer[PC]
Cool Shoes Software
P.O. Box 391
Burlington, MA 01803
(617) 229-9942
Inquiry 1059.

Dynamic Drums[PC]
New Wave Software
P.O. Box 438
St. Clare Shores, MI 48080
(313) 771-4465
Inquiry 1060.

Easy Performer[M]
Performer[M]
Performer 3.4[M]
Mark of the Unicorn
222 Third St.
Cambridge, MA 02142
(617) 576-2760
Inquiry 1182.

Finale[M]
MusicProse[M]
Coda
1401 East 79th St.
Minneapolis, MN 55425
(800) 843-2066
Inquiry 1061.

GenEdit[At,M]
Hybrid Arts
8522 National Blvd.
Los Angeles, CA 90232
(213) 841-0348
Inquiry 1062.

HookUp[M]
HIP Software
117 Harvard St., Suite 3
Cambridge, MA 02139
(617) 661-2447
Inquiry 1064.

Jambox[M]
M[Am,M,PC]
Upbeat[M]
Intelligent Music
116 North Lake Ave.
Albany, NY 12206
(518) 434-4110
Inquiry 1065.

Mandala[Am]
Very Vivid, Inc.
P.O. Box 127, Station B
Toronto, Ontario,
Canada M5T 2T3
(416) 686-7850
Inquiry 1066.

Master[M,PC]
CMS
382 North Lemon Ave.
Walnut, CA 91789
(714) 594-5051
Inquiry 1067.

MIDIBASIC[M,PC]
Altech Systems
122 Faris Industrial Park Dr.
Shreveport, LA 71106
(318) 226-1702
Inquiry 1068.

MIDI Quest[Am,At,M,PC]
Sound Quest
1573 Eglinton Ave. W, Suite 200
Toronto, Ontario,
Canada M6E 2G9
(800) 387-8720
Inquiry 1069.

Monitor[PC]
Bartleby Software
P.O. Box 671112
Dallas, TX 75367
(214) 363-2967
Inquiry 1070.

Notator[At]
C-Lab/DigiDesign
1360 Willow Rd., Suite 101
Menlo Park, CA 94025
(415) 327-8811
Inquiry 1181.

Personal Composer[PC]
Personal Composer
2448 76th Ave. SE
Mercer Island, WA 98040
(800) 446-8088
Inquiry 1183.

Sequencer Plus[PC]
Voyetra Technologies
333 Fifth Ave.
Pelham, NY 10803
(914) 738-4500
Inquiry 1184.

Showmaker[Am]
Gold Disk
P.O. Box 789, Streetsville
Mississauga, Ontario,
Canada L5M 2C2
(416) 828-0913
Inquiry 1185.

Super Librarian[Am,At,M,PC]
Pixel Publishing
1573 Eglinton Ave., Suite 3
Toronto, Ontario,
Canada M6E 2G9
(416) 785-3036
Inquiry 1186.

Sybil[At,M,PC]
Scorpion Systems
175 Fifth Ave., Suite 2624
New York, NY 10010
(415) 864-2956
Inquiry 1187.

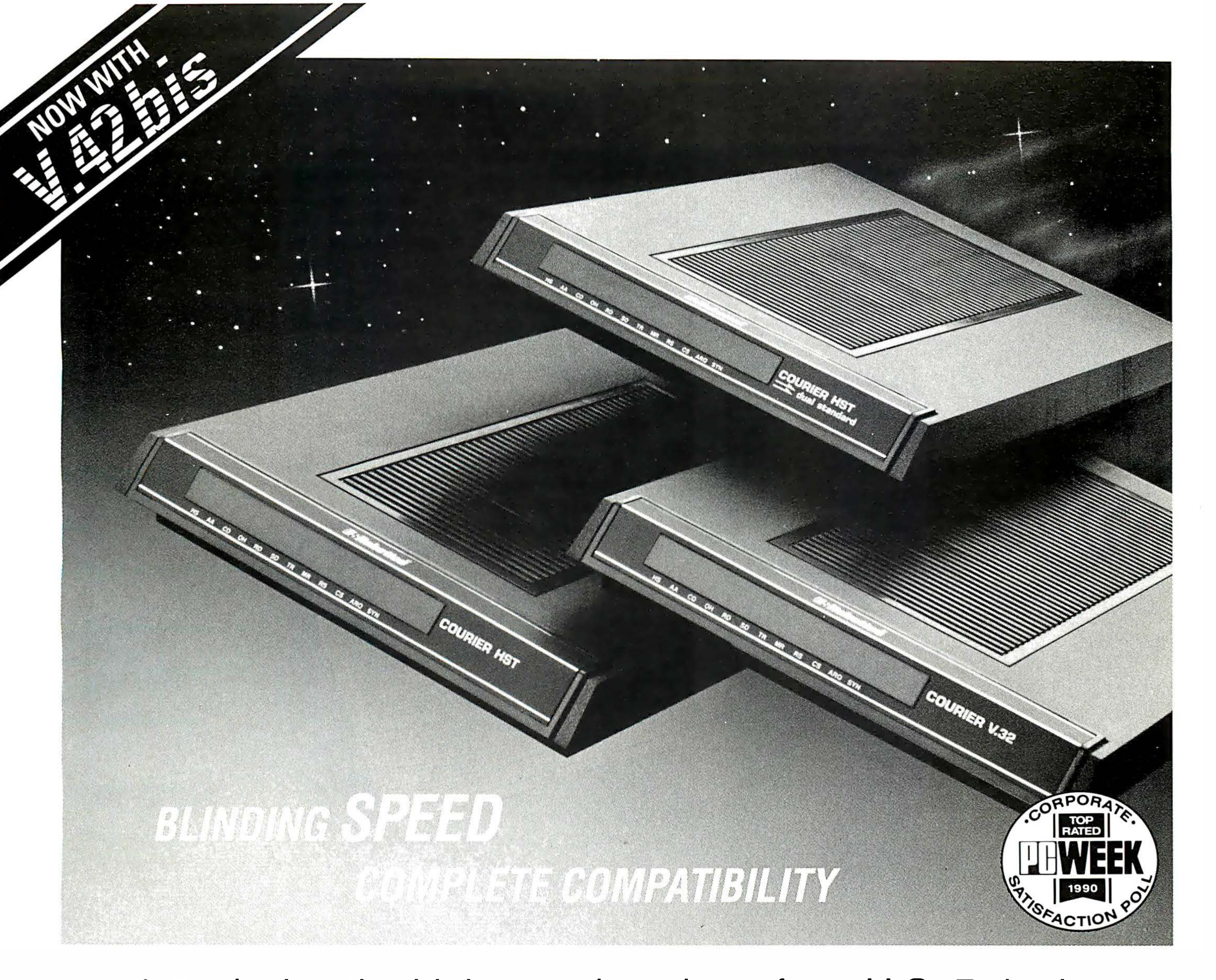
Synthia[Am]
The Other Guys
P.O. Box H
Logan, VT 84321
(800) 942-9402
Inquiry 1188.

incorporating music into multimedia environments will spawn more applications for integrating music with video, graphics, and other media. But it appears that the basic music software tools—the sequencer, the voice editor/librarian (see photo 2), and the notator—are already mature.

The next music software evolution is just now getting off the ground. It is occurring in tandem with an evolution in music hardware: software/hardware packages for digital multitrack recording direct to disk. Opcode and DigiDesign are working together to create a system that will access and control Digidesign's Soundtools system—a two-track, 16-bit, CD-quality digital recording module—from within Opcode's Vision sequencer. The merging of sequencing and digital recording represents the birth of the music workstation, and the ultimate realization of the home recording-studio-in-a-box fantasized by every musician that's ever yearned to produce master recordings.

In a world that is increasingly defined by how well we learn to communicate with and relate to computers, being able to work with them as fluid musical instruments and creative partners capable of warmth and subtlety of expression offers hope that our futures might not be as sterile and unfeeling as many sometimes fear. ■

Dean Friedman is a composer living in Peekskill, New York. Among his many compositions is the 1970s hit "Ariel." He is also the designer of the Nickelodeon game "Eat-a-Bug." Currently he is writing film and TV scores. He can be reached on BIX c/o "editors."



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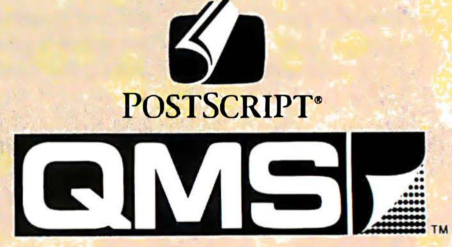
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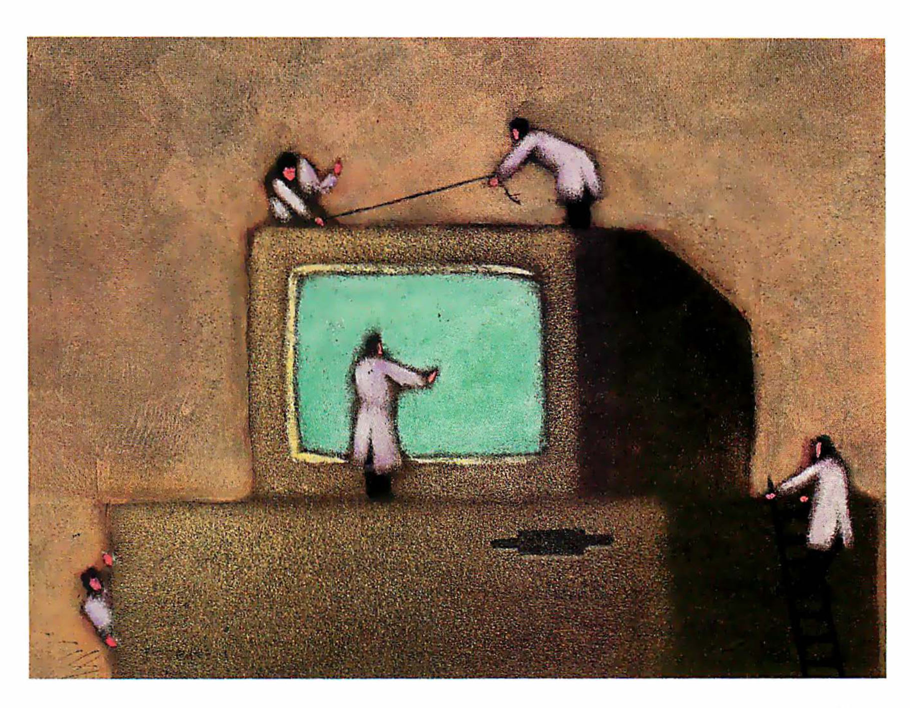
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OF MONITORS AND EMISSIONS

The least-changed computer peripheral is about to change



Unless you've confined your computing to an abacus, where the only emissions are splinters, you've probably heard about the controversy surrounding extremely low-frequency (ELF) and very low-frequency (VLF) magnetic emissions from video monitors. Whether the health hazards being blamed on such emissions are real or not, many manufacturers—especially those outside the U.S.—have begun producing so-called low-radiation monitors. In this month's Under the Hood, I'll take a look at display monitors and the steps that are being taken to reduce emissions from them.

Electronics and Emissions

Before you can reduce emissions from a video display terminal (VDT), you have to be able to identify the types of emissions and their origins. You should also observe the effects of such emissions and understand any regulations that apply.

Most electronic equipment produces two kinds of emissions: electric and magnetic. These emissions are emitted or radiated as electromagnetic energy fields. It is generally accepted that if the electromagnetic energy field produces ions while passing through matter, it is an ionizing field. If not, it is a nonionizing field. X-rays are an example of ionizing electromagnetic fields used to treat some medical conditions. Nonionizing fields are lower-frequency fields including ELF, VLF, radio, TV, and microwave communications.

To prevent misunderstandings, the scientific community generally refers to the propagation of nonionizing energy as emissions and the propagation of ionizing energy as radiation (see the text box "Clarifying the Confusion" on page 446). Therefore, it's inaccurate to consider ELF and VLF emissions as somehow related to ionizing radiations, such as those generated by x-ray or nuclear sources.

The electric and magnetic emissions generated by electronic equipment can be carried along conductors, such as power and interconnecting cables. Some components generate emissions during their normal circuit operation.

You've observed at least some effects from both of these types of emissions. The phenomenon is called electromagnetic interference. An example of conducted EMI is the disruption of TV reception by noise on the power line created by an electric shaver, a blender, or other electric devices. You've probably also noticed EMI as noise interference in audio systems, video displays, and telecommunication equipment.

Some earlier computer systems caused so much interference that you couldn't operate them in the same room with your radio or TV. Eventually, these systems were taken off the market because they couldn't be made to comply with emission requirements. Manufacturers found it was more cost-effective to design systems from the beginning to comply with regulations. You may begin to see this approach used to reduce video monitor ELF and VLF emissions.

The huge volume of complaints about EMI caused regulatory agencies worldwide to take action (see the text box "Who's Monitoring the Monitor Standards?" on page 448). One such U.S. agency is the Federal Communications Commission (FCC). One of its charters is to regulate the emission levels from computing equipment so they don't interfere excessively with licensed broadcast services.

continued

Clarifying the Confusion

Attenuation The decrease in amplitude of an electromagnetic emission during its transmission from one point to the next.

Deflection circuit A set of coils installed on the neck of a CRT. They control the movement of the electron beam across the CRT face when they are energized by the sweep frequency.

Electric field An electric flux density produced by a varying voltage.

ELF Extremely low frequency—the frequency range from 3 Hz to 3000 Hz.

EMC Electromagnetic compatibility—the ability of different electronic devices to work together without causing interference to each other.

EMI Electromagnetic interference—emissions that cause electronic equipment to malfunction.

Emission An act of dispersal. This term generally refers to electromagnetic energy.

EMS Electromagnetic susceptibility—how easily the operation of an electronic device is disrupted.

Filament voltage A voltage applied to the filament of a CRT. It heats the cathode to a point where electrons are emitted and then accelerated to hit the CRT's phosphor-coated face.

Hertz The basic unit of measure for frequencies (i.e., cycles per second).

Ionizing Any electromagnetic or particulate radiation capable of directly or indirectly producing ions in its passage through matter.

Isotropic probe A probe that has equal emission reception in all directions.

Magnetic field A state produced by a varying current flow in a conductor, which can induce a voltage in a second conductor.

Nonionizing Any electromagnetic radiation or emission incapable of directly or indirectly producing ions when it passes through matter.

Radiation 1) The emission of electromagnetic energy. 2) Moving nuclear particles.

Sweep frequency The amplitude-varying voltage applied to the deflection coils to move the electron beam across the CRT face. Horizontal frequencies range from 15,000 Hz to 32,000 Hz, and vertical sweep frequencies range from 50 Hz to 90 Hz.

VLF Very low frequency—the frequency range from 3000 Hz to 30,000 Hz.

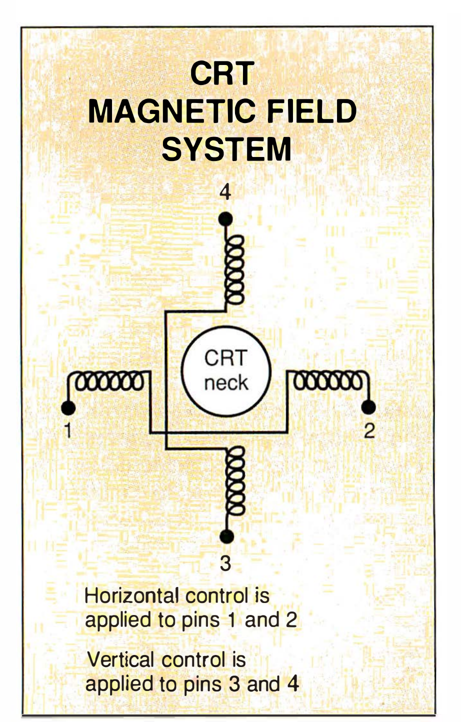


Figure 1: *A CRT magnetic deflection system positions the electron beam on the face of the CRT. Sweep frequency circuits apply voltages to the horizontal and vertical deflection coils to position the electron beam.*

FCC regulations set levels of conducted emissions over the frequency range of 450 kHz to 30 MHz and for radiated emissions from 30 MHz to 1000 MHz. They selected these frequency ranges to be sensitive to areas where receiving equipment exhibited electromagnetic susceptibility. The goal is to achieve electromagnetic compatibility, a condition that allows a variety of electronic equipment to operate in close proximity without interference.

Basic VDT Operation

The CRT is the main component in most VDTs. It has an electron gun that emits a beam of electrons. The beam is accelerated by a high voltage applied to the tube and strikes the CRT's phosphor-coated face. This coating glows when struck by the electron beam.

Control circuits are needed to adjust the intensity of the beam and move it across the tube's face to create a usable video display. Voltages are applied to the control grid to adjust the brightness of the CRT screen. The focus control adjusts the size of the electron beam image on the face of the CRT. The movement of the electron beam across the face of the tube is controlled by voltages applied to the horizontal and vertical deflection system (see figure 1).

The horizontal coils are energized by a sweep frequency that ranges from 15,000 Hz to 32,000 Hz, depending on the VDT's design. The resulting varying magnetic field moves the electron beam from side to side. A vertical sweep frequency ranging from 50 Hz to 90 Hz is applied to the vertical deflection coils, causing the electron beam to move up and down.

The majority of the emissions in the VLF region are a result of drive voltages applied to the horizontal deflection coils. Emissions in the ELF band come from two primary sources: the vertical deflection coils, which are energized at rates of from 50 Hz to 90 Hz; and power supply components, which generally operate from either 50 Hz or 60 Hz. Studies have shown that the emissions from color monitors are higher than those from similar-size monochrome monitors because of the higher operating voltages on color CRTs.

Research on the effects of low-level magnetic fields has gone on for many years and still goes on. Part of this research is focused on the effects of varying or pulsating fields, such as those found in the magnetic fields emitting from the CRT's deflection coils. There has been very little agreement on the

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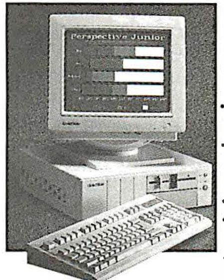
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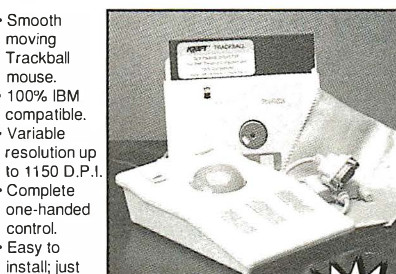
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Who's Monitoring the Monitor Standards?

In the past few years, improvements in display technology have rapidly taken place, and today, computer designers have many options. There are several advantages to each type of display. But as displays have evolved, so has concern over the emissions from CRTs and how to measure them.

In 1988, a standard was adopted by a Swedish commission regarding methods for measuring electrostatic fields and electric and magnetic alternating fields. While this regulation applies only to equipment imported into, or used in, Sweden, it does serve as a model for other countries, and we will probably see similar regulations enacted elsewhere.

In addition, some Taiwanese peripheral manufacturers have already embraced the concept of designing for reduced low-frequency emissions by beginning to produce lowered ELF displays. It is expected that VDT manufacturers worldwide may follow this lead.

In the U.S., IEEE Committee P-1140 has been formed and is meeting to review ANSI standard C95.1. It will evaluate measurement techniques and frequency coverage of the standard. One of the committee's action items is to consider increasing the standard's frequency range. Some members are p oposing that the range be extended down to as low as 50 Hz. It is possible that a first draft could be finished by mid-1991.

Interest in the ANSI standard rewrite primarily concerns how it applies to computing equipment, though C95.1 will also apply to other equipment that operates within this standard's frequency range. The p obable effect of the ANSI standard rewrite will be consideration of emissions and their levels in the lower end of the spectrum. Doubtless, all electronic manufacturers will be closely monitoring the outcome of the committee's deliberations.

Reducing ELF emissions is somewhat similar to reducing hydrocarbon emissions on automobiles. The basic operating characteristics of a vehicle are relatively unaffected by the modification. The same is true of a VDT. The reduced-emission CRT video monitor's operation remains essentially the same as the unmodified model.

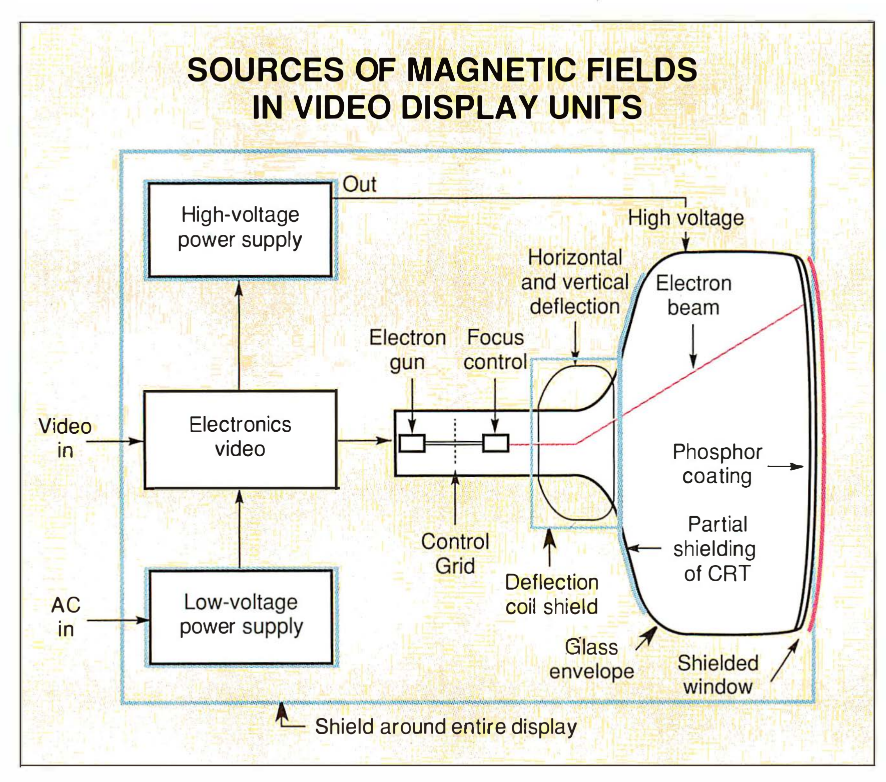


Figure 2: *The face of the CRT is shielded with a well-grounded EMI window. The CRT glass envelope, deflection coils, power supplies, and the terminal itself are shielded with metals that have good ferromagnetic properties and good conductivity, such as iron and nickel.*

validity and magnitude of the problem. Only a few countries, with Sweden in the forefront, have actually initiated standards regulating the levels of emissions in the VLF region.

What kinds of options are available to designers who are seeking to reduce the ELF and VLF magnetic emissions from VDTs? Unfortunately, there aren't many choices.

High- and Low-Frequency Emission Control

Computers are brought into compliance with earlier EMC regulations by applying techniques of circuit design that minimize the source of emissions and provide improved filtering and additional shielding. Radiated emissions requiring suppression were electric and could be shielded with thin sheet metal, metal screen, or even sprayed-on coatings. These techniques do not significantly contribute to the weight of the device, nor do they present unachievable constraints on the material selection or design of equipment enclosures.

By nature, electric and electrostatic fields are high-impedance and are easily contained by shields or screens. EMI-shielded windows are available that fit over the face of a CRT (see figure 2). An EMI-shielded window is a metal screen bonded to, or a thin-film metal deposit on, a glass CRT cover. Such shields will reduce VLF electric emissions by a factor of over 1000. The screen's attenuation of VLF magnetic emissions is so small as to be almost unmeasurable.

In contrast, magnetic fields are low-impedance. Reducing magnetic emissions begins with selecting the appropriate materials. Highly conductive materials, such as copper or aluminum, are excellent choices for reducing electric emissions but not magnetic emissions. Magnetic emissions are best reduced by using ferrous materials. Other materials can be used, but the electric

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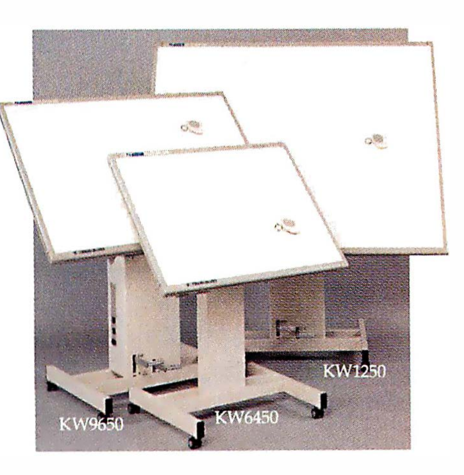


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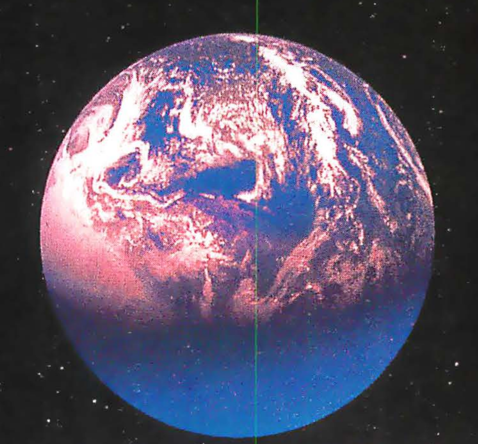




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While modern displays have high resolution and excellent color ranges, most are still built with CRTs that are really just big, obtrusive electron tubes.

and magnetic attenuation ratios will be similar to those of iron.

One way to shield against magnetic emissions is to place a 0.254-mm-thick iron sheet 10 cm from a 20,000-Hz emission source. The theoretical attenuation of the electric emission in this example will be by a factor of about 560 trillion. However, the attenuation of magnetic emissions is only about 1000. The attenuation of magnetic emission is even less as the frequency is lowered. The 60-Hz attenuation ratio is less than 3 for the above material.

Measurement Techniques

The analysis of electric and magnetic emissions from electronic equipment begins with the proper selection of the antenna/probe. The probe measures only selected electric or magnetic fields. It must not respond to spurious emissions that will interfere with the accuracy of the measurements.

The probe should be almost isotropic so that its response to an emission field is not dependent on the position of the probe. The design uses three dipoles for electric fields and three loops for magnetic fields, with one aligned with each of the *x*-, *y*-, and *z*-axes to achieve near-isotropic operation.

This is the preferred isotropic probe technique for manufacturing instruments that are used to test compliance with ANSI standard C95.1. This standard addresses safe levels of human exposures to radio-frequency electromagnetic fields in the frequency range of 300 kHz to 100 GHz. It starts at a higher frequency, and the field-strength levels are much higher than those from VDTs.

Currently, IEEE Committee P-1140 is working on an update of ANSI C95.1 (see the text box "Who's Monitoring the Monitor Standards?").

Equipment Changes

The computer industry has undergone tremendous changes since users first fired up their 16K-byte machines with their cumbersome cassette-tape storage and small TVs used for video display. Today's computers are much faster and more efficient, and they have almost unlimited storage capabilities. Yet the VDTs retain more similarities to those old TVs than differences.

While modern displays have higher resolution and excellent color ranges, most are still built with CRTs that are really just big, obtrusive electron tubes. At least they are relatively inexpensive and they can produce large, full-color images. The tube size usually determines the VDT's overall dimensions and

continued

weight. The tube requires a filament voltage, a high-voltage power supply, and deflection circuits, all of which can contribute to the VDT's ELF and VLF electromagnetic emissions.

Redesigning current video monitors could include adding shielding to the CRT body, magnetic deflection coils, and power supplies, and enclosing the entire monitor (see figure 2). The additional shielding, however, would add weight, increase cost, and make cabinet designs harder to modify. Better approaches include improving the circuit design, finding new ways to sweep the electron beam over the CRT face, or employing electrostatic deflection systems such as those used by most oscilloscopes.

Alternate Video Displays

Alternate display technologies are evolving in three main areas: gas-plasma, electroluminescent, and LCD, which is used in many portable computers. This reduction in display excitation voltage will reduce the magnitude of display-related electromagnetic emissions.

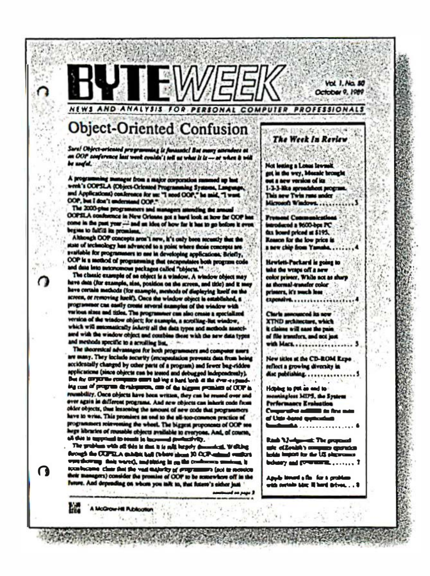
The size and resolution of today's alternative displays are not equal to those of CRTs, but they are rapidly improving. Some manufacturers are responding to the debate about low-frequency emissions by offering VDTs with specified lower-level magnetic emissions. Two Taiwanese companies offering such monitors are ADI Systems and Copam Electronics. Both are medium-size monochrome monitors.

Other manufacturers are beginning to offer flat-panel displays such as the Philips PM 12522. This unit is advertised as being completely free of emissions and generating virtually no heat. It has a 640- by 480-pixel, 12-inch LCD screen.

The future of monitors is wide open, with many possibilities in the offing. Already being considered are holographic and optical-projection monitors that will produce three-dimensional displays. Emission levels should be lower, because this type of equipment will be easier to shield than current CRT monitors. Tomorrow's displays will have greatly reduced ELF and VLF magnetic emissions by using either redesigned CRT displays or alternate display technologies. ■

Bill McGinnis is manager of the RF Measurements and Analysis Section for the Southwest Research Institute, a nonprofit R&D organization in San Antonio, Texas. He has over 25 years of experience with electromagnetic compatibility measurements, analysis, and design. He can be reached on BIX c/o "editors."

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These are the days of DOS extenders, of the mutated MS-DOS. If you could hear the dialogue of an interaction between modern applications and MS-DOS, it might go something like this:

MS-DOS: "I have all this data I need to put in memory, but I seem to have run out of usable RAM."
Application: "No problem, here's an extra 2 megabytes. I'll put the data there for you."
MS-DOS: "Two megabytes! How'd you do that?"
Application: "Never mind, just give me the data and don't ask for details."

This is information-hiding on a grand scale. MS-DOS is unaware of any memory lurking past 1 MB, and all these TSR programs and EMS drivers transport data in and out over that border like worker termites tending to an imprisoned queen. It's a grim scene, but you can at least comfort yourself by witnessing all the useful work that MS-DOS continues to do.

Some time ago, I put together a memory management system that uses handles as a means of coping with memory fragmentation in MS-DOS. (See "If Memory Serves...," August 1989 BYTE.) The system works well enough, but it suffers from the same memory restriction that MS-DOS does: The upper limit is 640K bytes, less the memory used by the operating system and application code. Since knocking down walls seems to be a trend these days, I decided that it was time to breach the 640K-byte barrier.

This month, I'll present an upgraded version of my handle-based memory management system. The upgrade consists of swap capabilities: This new memory manager uses EMS memory (if present), as well as a swap file on the disk. (See the text box "Using EMS" on page 459 for an explanation of how expanded memory is implemented.)

The Swap

The insides of this version of my memory manager operate much like the previous incarnation. Your application makes a request for a chunk of memory. The manager carves a slice out of the heap, tags the slice with an m-node, and passes the m-node's address back to your program. When your program is done with a piece of memory, your application informs the memory manager accordingly, and the memory chunk's associated m-node is flagged to indicate the memory block is not in use. Memory allocation and release is dynamic.

As before, when the memory manager receives a request that cannot be fulfilled, it attempts to compact the heap in order to consolidate separate "bubbles" of unused memory into a large contiguous free block. This is fine as long as the net amount of memory requested does not exceed the limit of the heap. Once requests do exceed heap size, you're simply out of luck.

Now, however, I've given the memory manager an extra option: It can attempt to swap unlocked blocks either into EMS RAM or off to the disk. Naturally, for the sake of speed, the memory manager will take a crack at EMS first. Blocks that are swapped to EMS or to disk release their memory back into the heap so that the request that triggered everything can be fulfilled.

continued

It works like this: Suppose the application program makes an 8K-byte request, and that the map of memory usage looks something like the diagram in figure 1a. Since the largest free block is only 3K bytes, the memory manager performs a compaction. The result is shown in figure 1b. Once again, the memory manager looks for a free block to satisfy the 8K-byte request, but it discovers that the largest free chunk it has been able to scrounge together is 6K bytes. It's time to do some swapping.

So, the memory manager starts at the top of the m-node list and works its way down, keeping a running total of free and unlocked memory. Once this total meets or exceeds the requested amount, the memory manager begins swapping used blocks out to EMS or disk, consolidating the freed memory as it goes. In the example in figure 1c, the memory manager swaps out the 6K-byte block referenced by m-node A and combines it with 6K bytes of already-free memory, for a total of 12K bytes. The 8K-byte request can now be satisfied.

Notice that the memory manager moves down from the top of the m-node list in its search for blocks to swap (another payoff for having the m-nodes on a doubly linked list). The selection method used is a first-fit algorithm, since it stops as soon as it's found a contiguous set of blocks that satisfies the original request. An advantage of this technique is that it saves the memory manager from having to perform another compaction after the swap. Newly freed blocks are immediately concatenated to already-free memory that has bubbled up to high memory in the preceding compaction.

Since the m-node of a swapped block is pulled out of the list altogether, the application had better not lose the m-node number. Of course, this is true of m-nodes in any case—if you forget an m-node number, there's no real way to get it back. However, in the original memory manager, m-nodes were kept on one of two lists: an in-use list of m-nodes referencing blocks in the heap, and a "free" list of m-nodes that weren't attached to any heap memory blocks. The free list supplied m-nodes to the in-use list as the heap was carved into more numerous pieces. Now, m-nodes swapped out to EMS (or to the disk) simply hang around in limbo until the application requests the data that the m-nodes are riding herd on.

The M-Node

My original version built a doubly linked list of pointer blocks that I dubbed m-nodes. Each m-node was 4 words big and consisted of the following:

- a base address, which pointed to the start of the referenced memory block;
- a length word, which indicated (in paragraphs) how big the referenced memory block was;
- a next m-node field, which pointed to the following m-node in the doubly linked list; and
- a previous m-node, which pointed to the preceding m-node in the list.

My program kept m-nodes arranged in memory so that as you traversed the list "upward," you moved through m-nodes that referenced memory blocks stored at

continued

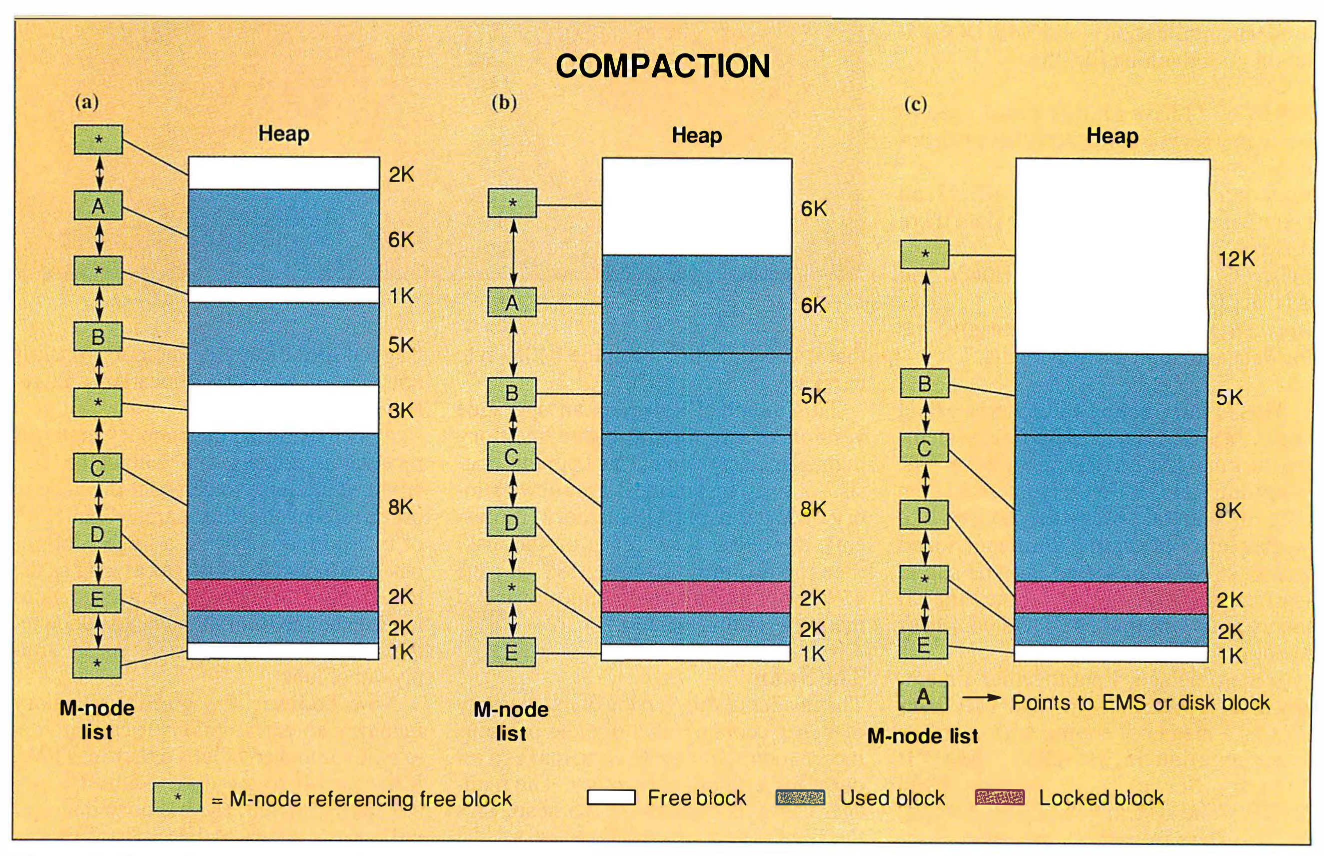
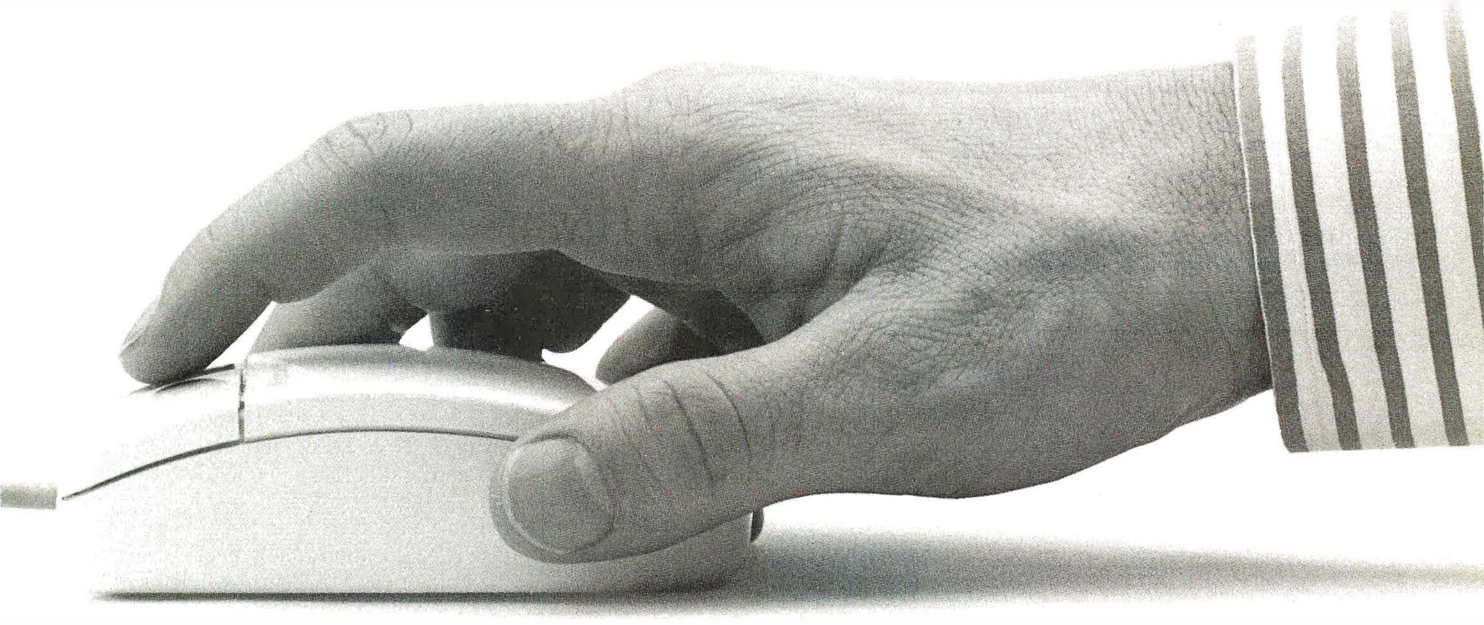


Figure 1: *Swapping memory out of the heap begins when a memory request comes in.*
(a) *The request is for 8K bytes, and no free blocks of 8K bytes exist.* **(b)** *The memory manager compacts the heap, freeing a block of 6K bytes. Not good enough, so* **(c)** *the manager swaps a 6K-byte block out to EMS memory or disk. A 12K-byte block is now available, and the 8K-byte request is granted.*

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higher and higher addresses. Furthermore, adjacent m-nodes referenced adjacent memory blocks. That—and the fact that the m-node list was doubly linked—made the compaction algorithm easier to code.

I borrowed the most significant bit from the next and previous m-node pointer words to act as status indicators. I used one to indicate when the m-node was pointing at a used block, and another to indicate if the block was locked (i.e., could not be moved during compaction).

As far as the m-node is concerned, not much has changed in this updated version (see figure 2). The only real alteration is that I've now stolen 2 bits each from the top of the next and previous pointers. (In case you're worried that this has reduced the number of m-nodes that the linked list can bear, don't. Fourteen bits is still enough to reference 16,000 m-nodes, the maximum number that you'd be able to fit in a single 64K-byte segment anyway.)

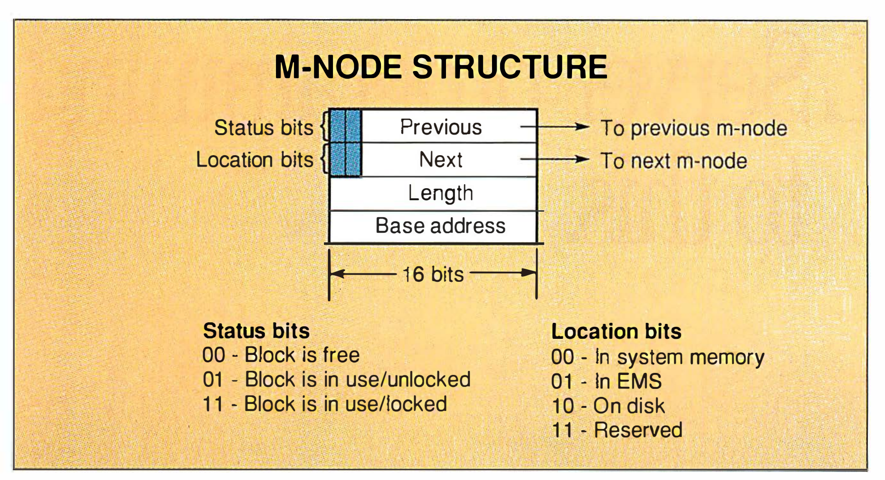


Figure 2: *M-nodes are "tags" for memory blocks, whether those blocks are in the heap (in system memory), in EMS memory, or on the disk.*

Figure 3: *Each 16K-byte EMS page is divided into 128 blocks of 128 bytes each. In this figure, a chunk of heap memory has been swapped to EMS memory, and its data occupies EMS blocks 2, 4, and 7 on this EMS page. The MAT entries form a chain, linking the pieces of the data. Each MAT entry carries the EMS page number and block offset of the next entry in the chain, so MAT entry chains can stretch across several EMS pages.*

The 2 bits at the high end of the *previous m-node* field are the status bits, as before; they tell if the block is in use and, if so, whether it is locked or movable. The two highmost bits of the *next m-node* field indicate the current location of the memory block that the m-node references, whether it's in system memory, EMS memory, or the swap file. Whenever the system has swapped out a memory block and the application program tells the memory manager to go fetch that block, the memory manager looks at the location bits to see where it put the data. Consequently, the format and contents of the base address pointer change if the referenced block is either in EMS or on the disk.

EMS and MATs

Rather than attempt to treat EMS memory as an extended heap, the memory manager subdivides each 16K-byte page of EMS memory into 128 blocks of 128 bytes (see figure 3). The first two blocks on an EMS page (i.e., at the lowest memory address) hold a table of 16-bit pointers. I'll call this table the MAT (for memory access table and in honor of the disk file allocation table), and I'll refer to the pointers as MAT entries. Each MAT entry "manages" one of the 128 remaining blocks in the page.

MAT entries serve as members of linked lists. The low 9 bits of a MAT entry hold the next EMS page in the list, while the high 7 bits hold the 128-byte block number on that page. When you initialize the memory manager, all the EMS memory it is able to obtain is free, so all MAT entries are placed on a single, huge, free list. As the manager moves data into EMS, it pulls MAT entries off the free list one by one, copies data into the corresponding block in EMS memory, and links the MAT entries into another list anchored by an m-node.

This explanation demands an example. Suppose the memory manager has determined that it must move a 256-byte memory block into EMS memory. The program checks at the head of the free MAT entry list and, from that, determines the page and block number of the first free MAT entry. The program then

continued

Using EMS

The memory manager described in this month's article uses a subset of all the functions provided by EMS 4.0. Furthermore, the technique by which the memory manager swaps data between the heap and EMS is not the only way to do it; depending on the final application, there could well be more efficient uses of EMS as swap space than the one I've chosen.

It's easiest to think of EMS memory as memory that's "off to the side"; DOS isn't aware of it until the expanded memory manager (EMM) goes to get it. You can have up to 32 megabytes of EMS memory available (my memory manager will attempt to grab, at most, 8 megabytes), carved into blocks of 16K bytes each. Such a block is referred to as a *page*.

Before a program can use EMS, it must first verify that an EMS driver is present in the system. You do this by calling function 35H of the standard DOS INT 21H; this is the DOS function for retrieving an interrupt vector. Specifically, you're looking for the interrupt vector for interrupt 67H—the interrupt that an EMM drive (if present) will connect through. So, the call looks like this:

```
MOV     AL,67H
MOV     AH,35H
INT     21H
```

and when it returns, the ES register will contain the segment where the driver starts. Ten bytes into that segment, your program should find the string "EMMXXXX0." If that string isn't there, no EMS driver is in the system. Usually, this is sufficient to proceed. But if a program is overly cautious, it might execute an INT 67H with the AH registers loaded with a 40H. This is the EMS *get status* function; it returns information in the AH register that indicates whether the EMS hardware and software are operating properly.

Your program's next job is to find out if there's enough EMS memory free for whatever task the application has lined up. For this, you call the EMS *get unallocated page count* by issuing an INT 67H with the AH register loaded with 42H. On return, you'll find the total number of EMS pages in the DX register, and the number of unallocated pages (i.e., those not already claimed by someone) in the BX register. If there is enough EMS memory, your program should then load BX with the number of pages it wants and issue an INT 67H with AH loaded with 43H, the *allocate pages* function. (All EMS functions return an error code in the AH register. It's 0 if the function was successful. I'm assuming that your program is checking AH after each call to EMS to verify that things are running smoothly.)

The allocate pages function returns a *handle* in the DX register. Actually, the handle is in the low 8 bits of the DX register, but the EMS specification forbids your program to modify the upper 8 bits of a handle. This handle is a unique number between 1 and 255 that identifies the set of EMS pages you've just allocated. Of course, your program can simply grab all the pages it needs up front and use only one handle (this is what my memory manager does). Or, you might want to logically group portions of EMS memory so that pages used by one set of routines are referenced by one handle, while pages used by another group of routines are referenced by another handle.

To actually use your EMS pages, you "map" them into a region of memory below the 1-MB horizon referred to as the page frame. Here's where you get into a distinction between *logical* and *physical* pages.

A logical page is a member of that set of pages you have allocated. The EMS gave you a handle to that set. You reference a logical page by a sequence number; so if you allocated *n* pages, the sequence numbers range from 0 to $n-1$.

A physical page refers to the location in conventional memory where the logical page will "appear" when you map it in. Typically, the physical pages are located in the page frame, which shows up at the 768K-byte mark, just above the video memory region and adapter card memory. Physical pages are the same size as logical pages and are numbered from 0 up through the number of physical pages that the EMS driver supports. (The location of physical pages is not this restricted across all EMS implementations, and there are EMS functions that return the addresses of physical page locations.)

So, if you want access to logical page 4 through physical page 0, your program would execute the following:

```
MOV     AH,44H
MOV     AL,0
MOV     BX,4
MOV     DX,handle
INT     67H
```

where `handle` is the handle that EMS gave you when you allocated your logical pages. When this code fragment executes, logical page 4 is accessible at memory location C000:00 (768K).

Finally, when your program is finished with EMS memory, it's a good idea to return the memory to the system. You do this by issuing an INT 67H with the AH registers set to 45H and the DX register holding the handle. This is the *deallocate pages* function, and it releases pages your program had commandeered. Without it, successive execution of programs would claim more and more EMS memory until the well simply dried up.

Of course, there are many more EMS functions than those I've covered here. Your program can alter the page size—in which case you'll be dealing with what are referred to as "nonstandard pages." There are even powerful block move functions that allow you to blur the lines between the pages: Your program can copy chunks of memory larger than 16K bytes to and from EMS (or from one location in EMS to another), and the driver will handle the details of the data spilling over the top of one logical page and into the bottom of the next logical page, as well as deal with the headaches of overlapping source and destination.

To actually use your EMS pages, you "map" them into the page frame.

loads the associated page into the page frame and copies the first half of the 256-byte block into the 128-byte EMS block referenced by the MAT entry. It does the same with the second half of the 256-byte block: locating a free MAT entry, loading the page, and copying the data in.

Next, the memory manager sets the first MAT entry's contents to point to the second MAT entry, thus constructing a chain that links together the two halves of the original 256-byte block. The memory manager anchors this chain to the m-node that originally pointed to the 256-byte block by linking the first MAT entry into the m-node. This linking process is simply a matter of copying the MAT's page/offset word into the m-node's base address field. Finally, the memory manager detaches the m-node from the in-use list and makes its associated heap memory available for use.

Of course, the software has set the original m-node's status bits to indicate that the data referenced by that m-node is now off in EMS memory. So, the next time the application wants that data in memory, the memory manager looks in the m-node, sees that the data is in EMS memory, and follows the chain of MAT entries to pull the data back together.

Swap File

Once conventional memory has been consumed, the memory manager takes a whack at moving things out to EMS memory. If EMS memory is either not present or filled, the memory manager turns to the swap file on the disk. (The reason for the system's choice of EMS memory over the disk should be obvious: speed.)

Memory is kept in the swap file in 1026-byte records. The arrangement is illustrated in figure 4, and you can see that the first 2 bytes of each record serve to hook the records together in yet another singly linked list. The list is anchored by an m-node in memory that points to the last record of the list—the base address field of the m-node holds the record number. When swapped out to disk, a memory block from the heap is spread through the swap file in a chain of 1K-byte records. As you can see, swapping to disk works conceptually just like swapping to EMS memory.

Perhaps you found it odd that the m-node points to the last record of the list (by "last" I mean that record holding the data that is loaded at higher addresses when the block is in the heap). I chose this scheme to minimize the disk's head movement as records are being written out. If the records were connected by forward links—with the m-node pointing to the first record of the list—imagine what would happen as a memory block was being written out. The memory manager would write out the first record, allocate the next record, go back to connect the first record to the second, return to the second record to load it with data, allocate the third, and so on. Before the memory manager could write a new record, it would have to go "back" to the previous record to build the forward link.

In my scheme, the memory manager simply remembers the record number just written and writes the backward link followed by the actual data in one swoop. The moral: It is easier to remember where you came from than to know where you're going.

Conceptually, swapping to disk works just like swapping to EMS. A block from the heap is carved into 1K-byte chunks that are moved out to the disk. On the disk, these chunks are connected by a

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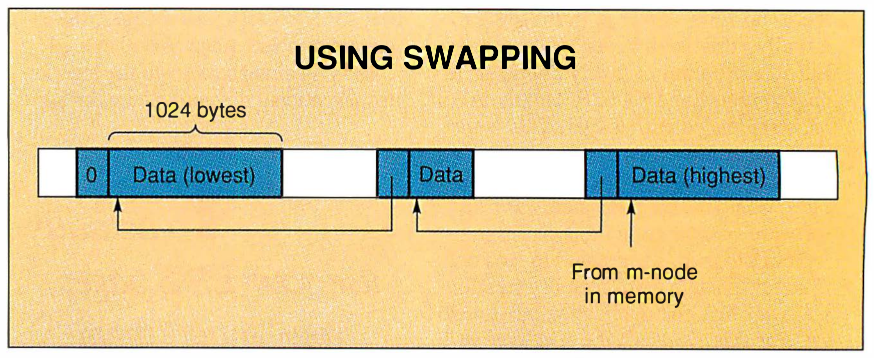
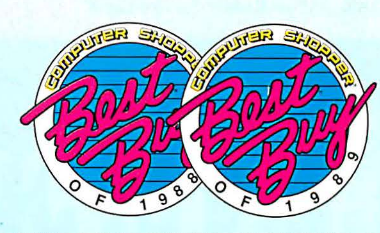
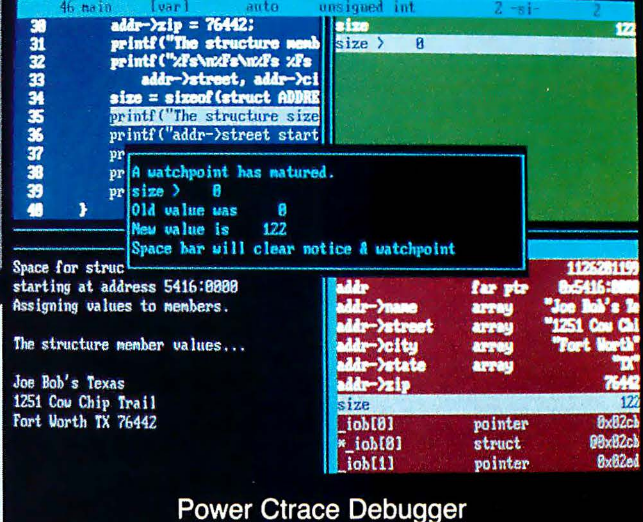


Figure 4: *The swap file is divided into records of 1K + 2 bytes. The first 2 bytes serve as links in a backward-pointing chain. Data swapped out of the heap is chopped into 1K-byte pieces when written to the swap file. Note that the head of the chain actually begins with the record storing the data to be loaded highest in memory.*





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The key is to identify local behavior in programs. Before a program enters a loop that accesses blocks that have already been allocated, lock those blocks.

chain of pointers ultimately linked to an m-node.

Lock Those Blocks

Anytime a system gets this complex, loopholes appear. In particular, suppose you've maxed out system memory, and you make a request for a 16K-byte block. Well, the memory manager will first try a compaction—which will fail—and then it will proceed from the high end of memory, swapping unlocked blocks out to the disk. Let's say it swaps out two 8K-byte blocks, freeing up enough space for your 16K-byte request. You store some data in your newly acquired 16K bytes, and then you turn around and request something out of one of the 8K-byte blocks that just got swapped out to disk. Well, the system has to go back, move the brand-new 16K-byte block out, and move that 8K-byte block back in. You could be in for some thrashing, as a small subset of memory blocks are swapped back and forth.

The solution is to lock the memory blocks that you expect to access frequently. This will keep them from getting swapped out. In the example I just gave, if you lock the 16K-byte block as well as the two 8K-byte blocks, some other blocks (that we will presume are not currently being accessed by the program) will be swapped out instead.

The key is to identify local behavior in your programs. Before your program enters a tight loop that accesses several blocks that have already been allocated, lock those blocks. In this way, they won't get swapped, and your program won't have to be continuously passing through the handle-to-address calculation routine.

continued

Finale

You might be tempted to try your hand at more complex swapping algorithms; I'm sure plenty abound. But beware: You'll be treading into the domain of the classic knapsack problem (see my June "Cloak and Data" column).

Imagine that you are given a box (dimensions specified) for which you have to select blocks from a pile of random sizes. The selection must fit the box with the least wasted space. You are into a problem that—in the general case—is computationally intractable. But this is precisely the sort of situation you face when trying to determine what combination of blocks in the heap would satisfy a given memory request. Unfortunately, an algorithm to solve such a problem in a reasonable amount of time doesn't exist. If it did, you could immediately rewrite the memory manager to be vastly more efficient than what I've provided.

Another approach at improving the swapping routine would be to add some sort of usage information to the m-node. This would enable you to put together a least-recently-used (LRU) swapping algorithm, so that freshly allocated blocks would tend not to be immediately swapped out (this would ease the thrashing headache I mentioned in the preceding section).

There would be an added complication: Currently, since the swapping routine swaps out blocks from the high end of the heap, it does not have to pass through another compaction to consolidate freed memory. In the general case, an LRU swapping algorithm would require a second compaction after the swap took place, since newly created (and therefore unswappable) blocks would have the effect of partitioning freed memory.

You may also want to modify the program's swap size. I chose a small size for EMS memory to reduce fragmentation; on average, there will be fewer unused bytes at the end of the last 128-byte EMS block in a chain than, say, a 1K-byte block. I chose a larger size for the disk to reduce access time (I was much less concerned about EMS access time). Had I chosen a small swap size for the disk, swapping out a large block would have required multiple disk accesses.

Of course, this means that there are more unused bytes at the end of the last disk block in a chain. Your application may allocate most of the memory it needs in chunks that are—on average—only 500 bytes. You may therefore want to set the disk swap size to, say, 512 bytes. Better yet, you could modify the memory manager so that, at initialization time, the application tells the memory manager what swap size to use for both disk and EMS. ■

Editor's note: *The routines described in this column are written in 8088 assembly. The complete source includes an interface to Turbo C (for MS-DOS). It is available in a variety of formats. See page 5 for details.*

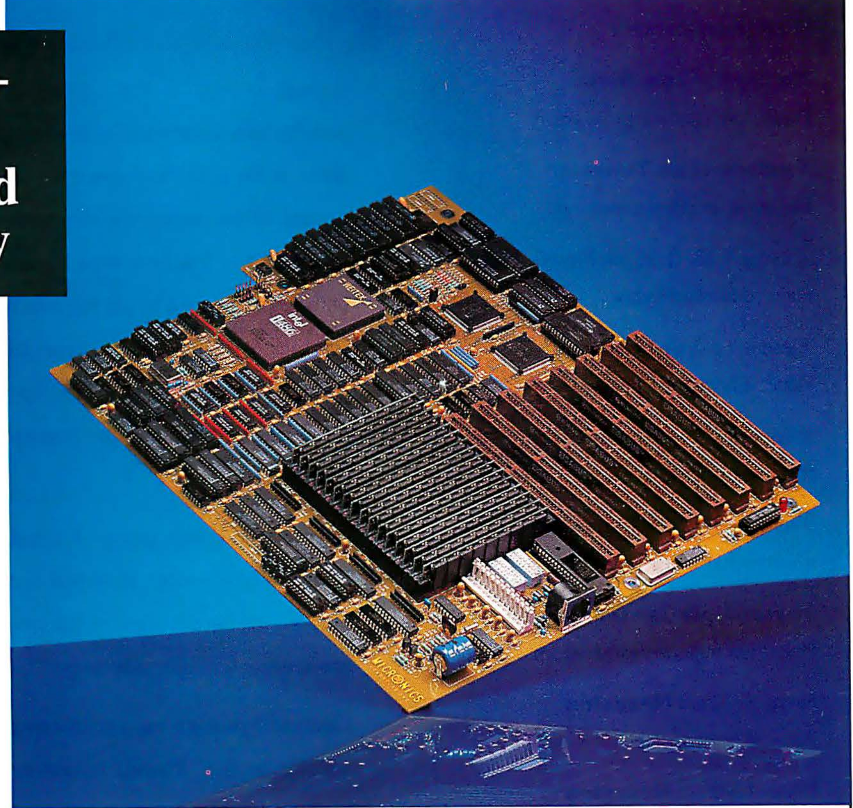
Rick Grehan is the director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in computer science/mathematics from Memphis State University. He can be reached on BIX as "rick_g."

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Monday 9–12 pm **Nexus Inn**
Place: d.horizons/cbix

Monday 9:30–11:30 pm **Boldseekers**
Place: the.realms/cbix

Monday 10–12 pm **Trivia**
Place: fun.n.games/game.room

Tuesday 9–12 pm **Times Inn**
Place: other.times/times.inn

Tuesday 9:30–11:30 pm **Heavy Metal**
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Tuesday 12–3 am **Nexus Inn**
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Wednesday 9–12 pm **Nexus Inn**
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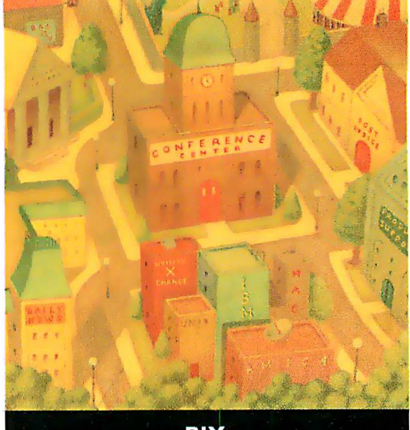
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All times are eastern. Description or rules for any of these events can be found in their appropriate conferences.

■ **Other Conference News and Events**—September always means a new school year. On BIX, you can meet with your fellow educators in the Education conference. The BIX Education conference has often been described as highend, but that doesn't mean the BIXen don't get down to the day-to-day operation of schools from pre-school



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through college. In this conference, you can also spend some time musing about public policy and where we are headed. BIXen present their own public awards to "Teachers Who Made a Difference" as a way to pay top educators back. Since BIXen tend to be people involved with technology, the spotlight often falls on Math and the Sciences. (join education)

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Are Compaqs so compatible and reliable that they're boring? Journalist Allan Davidson, the new moderator of the BIX Compaq conference, wants to hear your opinion. (join compaq)

Discuss the pros and cons of several different RISC microprocessors, including the 29000, SPARC, and R3000. (join cpus/risc starting at message 869)

BIX Exchange News

■ **IBM Exchange**—IBM CBix discussions begin nightly at 10 pm (eastern). (join ibm.exchange)

Repair to the 'ibm.repairshop' conference for two new topics: how to build your own IBM clone (clone.building); learn how they work (electronics). (join ibm.repairshop)

■ **Mac Exchange**—When is WYSIWYG not needed? When is it needed and why? In September subscribers to the BIX Macintosh Exchange will continue their discussion on what would make the "perfect" Mac word processor (also known as the "Word 5.0 wish list"). They'll be looking at all the aspects of this and other word-processor attributes in 'mac.business.' (join mac.business)

A careful eye will be kept on Cupertino for any product announcements. Check out the 'rumors' topic in the 'mac.sandbox' conference. (join mac.sandbox)

■ **Writers Exchange**—You'll find regular market news postings for writers. (join writers/markets)

Hugh Kenner discusses the art of writing in 'writers.' (join writers)

■ **Telecom Exchange**—New topic: get the facts on FAX technology. (join telecomm.tech/fax)

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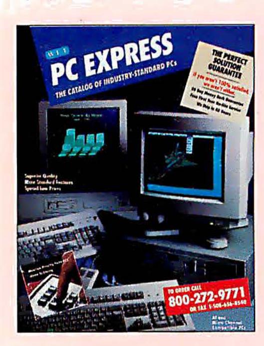
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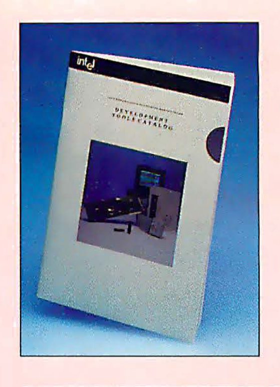
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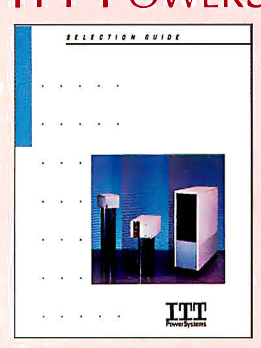
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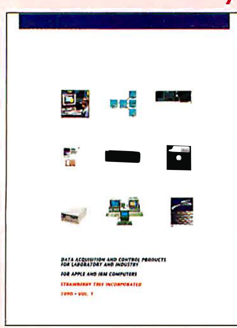
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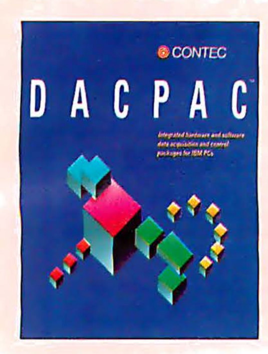


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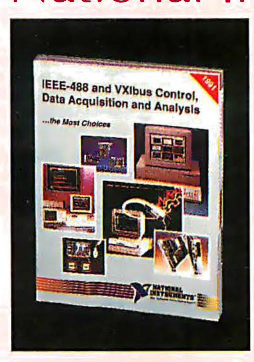
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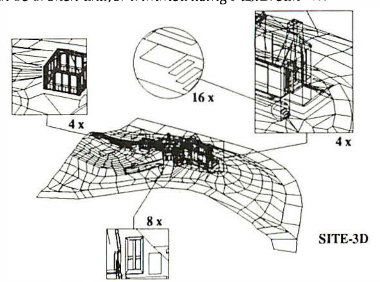
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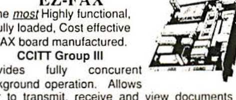
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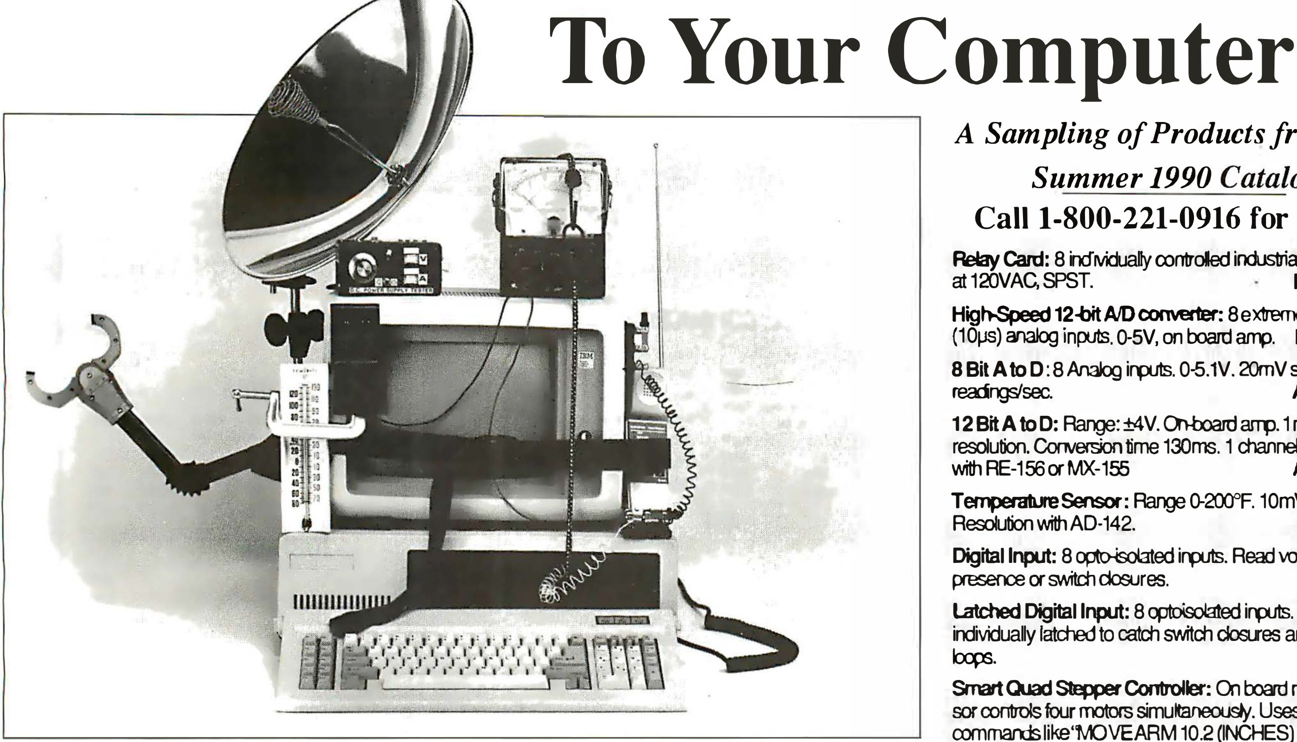
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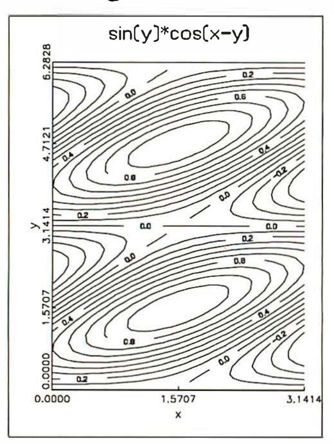
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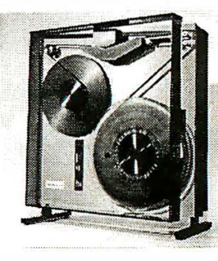
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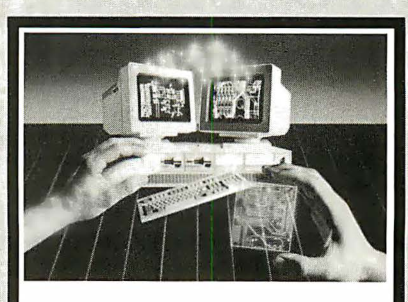


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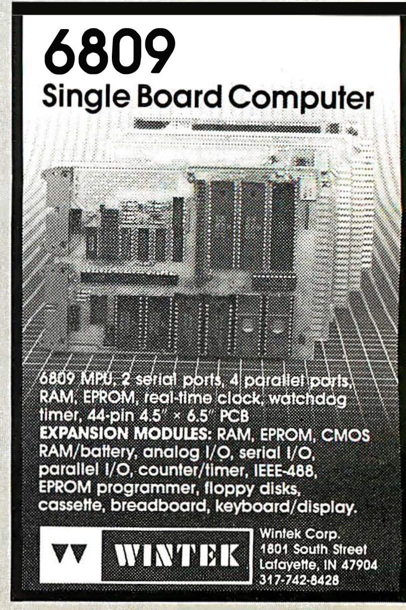
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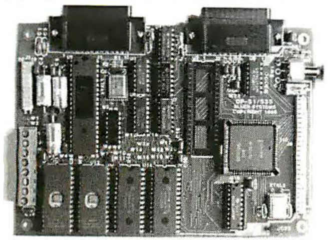
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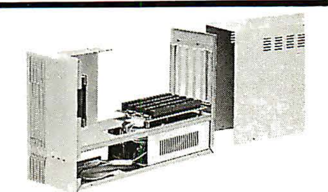
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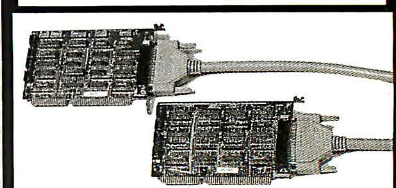
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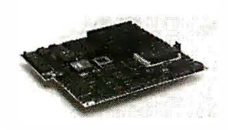
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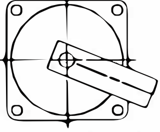
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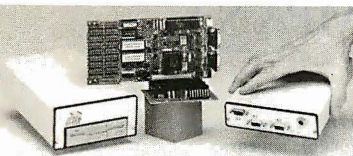


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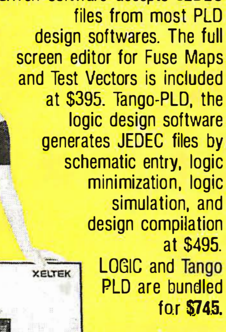
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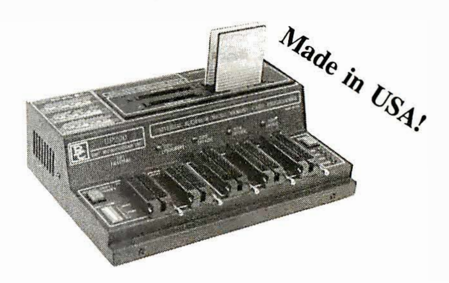
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16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1–25
19 ☐ 26–50
20 ☐ 51–99
21 ☐ 100 or more

Inquiry Numbers 1-495

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Inquiry Numbers 496-990

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Inquiry Numbers 991-1479

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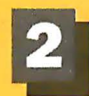
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Company

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City State Zip

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1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level 9 ☐ Professional
8 ☐ Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes 11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS 15 ☐ UNIX
13 ☐ DOS + Windows 16 ☐ MacOS
14 ☐ OS/2 17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1–25 20 ☐ 51–99
19 ☐ 26–50 21 ☐ 100 or more

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Inquiry Numbers 1-493

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Inquiry Numbers 494-986

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Inquiry Numbers 987-1479

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41256-120	262144x1	120ns	16	2.95
41256-100	262144x1	100ns	16	3.15
41256-80	262144x1	80ns	16	3.75
414256-100	262144x4	100ns	20	12.95
414256-80	262144x4	80ns	20	13.45
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PART#	SIZE	SPEED	FOR	PRICE
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41256A9B-80	256K x 9	80ns	SIMM/PC	49.95
421000A8B-10	1MB x 8	100ns	SIMM/MAC	109.95
421000A9B-10	1MB x 9	100ns	SIMM/PC	113.95
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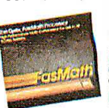
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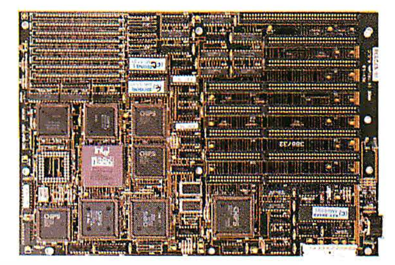


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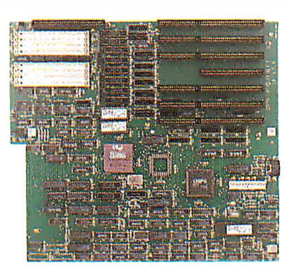
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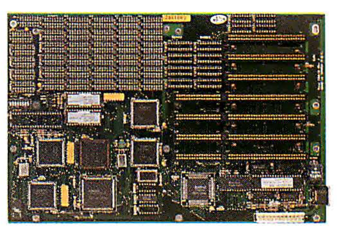
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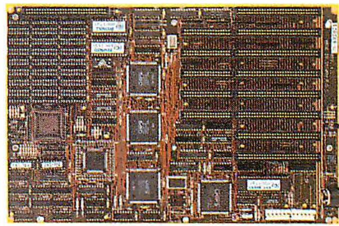


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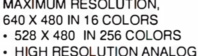
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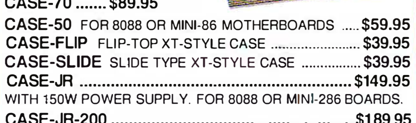
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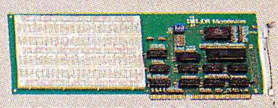
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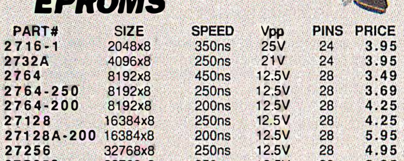




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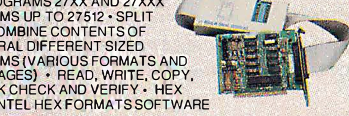
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Chaos Manor Mail

Jerry Pournelle answers questions about his column and related computer topics

Lefties Unite

Dear Jerry,

Could I ask you to take up the cudgel on behalf of an undefended minority? We lefties are used to being called "sinister" and "gauche," and we've adapted remarkably to a hostile world, but sometimes it seems to have gone too far in its oppression.

Logitech seems to have come out, finally, with the perfect trackball in the TrackMan. It is, however, unrelenting in its right-handedness. A few inquiries to Logitech force me to conclude that the company has no plans for a left-handed model. Were the company to make one, thousands of us southpaws would flock to it—in gratitude, if nothing else. Perhaps you could put a few bees in Logitech's (or somebody's) bonnet.

David A. Frecker
Corpus Christi, TX

I think you should take up your Bible and look into Matthew 21. Actually, if a right-handed trackball becomes a commercial success, a left-handed one will not be far behind, while saddling a company with the necessity to do both when introducing the product is a fair way to prevent it from happening at all.

I find that my computer table isn't set up for a trackball, which is a surprise; I need one that is 3 inches wide or less so that it will sit in my keyboard drawer with my keyboard.—Jerry

BASIC Fear and Loathing

Dear Jerry,

You and others said nice things about QuickBASIC 4.5, so I persuaded my wife to buy it for me.

Although I last professionally programmed in about 1972 (PL/I on an IBM 360), six years ago I used the family Apple II to write a boat-race scoring system for the junior section of our local sailing club. This resulted in a loss of all human knowledge of how to score the races, so when my home computer changed to a PS/2, I needed to rewrite. Hence, I used QuickBASIC.

First, all went well—it was a super new environment, had great color, could validate input every which way, and could tidy everything away in subroutines. Maybe I went overboard in trying these things; I'd be the last to claim that the resulting code was neat, disciplined, or elegant. But beyond a certain size, the RUN instruction locked the machine with no error message—which I take to mean that the product, and not my code, is at fault.

I called the Microsoft help number in the U.K., and the people there said to save the code in a text file, not the special fast file type supported in QuickBASIC. They called it "binding." This worked for a while, but then the program hung again.

Is this binding peculiar to QuickBASIC 4.5 (maybe the European version), or is it a well-known though undocumented characteristic of QuickBASIC?

Garry Owens
Dublin, Ireland

I haven't had your problem, although I am told that if a program gets extremely large it can happen, and the code must be compiled external to the programming environment. I always compile externally anyway, because the internal compiler links in all the library routines whether used or not, resulting in enormous code.

I also recommend the Crescent QuickBASIC toolkit.—Jerry

APL Minority

Dear Jerry,

I must take issue with a comment you made in response to a letter regarding a system that was written in APL (December 1989). In these days when the trade magazines are full of warnings regarding the amount of experience needed to code C for Presentation Manager, it sounds odd to me that someone would make a remark about not wanting to maintain APL code. I personally wouldn't want to maintain C code, but that is because I am so inexperienced with C.

I also don't choose to read and write Russian, but that is not a reflection on Russian; it's a reflection on the fact that I am not literate in Russian. I am very literate in APL, however, and I think I could maintain just about any system written in one of its several dialects.

Unfortunately, there are not a whole lot of programmers who are APL-literate. This, however, has not prevented novices from coding in APL, and there's a lot of code written in APL by people who have not been professionally trained to code within standards of readability, documentation, or efficiency. Nevertheless, they get the job done—and leave the maintenance for others. My years of experience at several companies have indicated that code written by novices is far more difficult to maintain than sophisticated code written by professionals. This has led me to believe that the problems programmers have with APL have more to do with their competence level (literacy level, if you prefer) than with the language.

So while you may not want to maintain an APL system, I thrive on doing so. On the other hand, I would not ask someone to pay me to maintain C code.

Gregg W. Taylor
Keller, TX

I agree that there are not many people who are APL-literate. I am persuaded that it is a wonderful language for the small number of people who are.—Jerry

Computers for Cetaceans

Dear Jerry,

I am a marine biologist with the University of Houston–Clear Lake Dolphin Research Team. The Dolphin Research Team is a volunteer organization consisting primarily of behavioral psychologists and environmental biologists. Although UHCL gives us office space, we depend entirely on donations to continue operating.

The primary objectives of the research team are interdisciplinary behavioral research and public education about marine mammals and their role in the marine environment. The research consists of observation of wild populations of dolphins near Galveston Island, compilation

of a fin photo-identification catalogue, and anatomical studies of dolphin corpses and skeletons.

To raise awareness and educate the general public about dolphins and their relation to the marine environment, team members have assisted in painting two cetacean murals on Galveston's seawall, writing and publishing a booklet called *Galveston's Dolphins*, and assembling a skeletal display at UHCL. In addition, team members regularly give presentations to all interested groups. The research and education that the team participates in is important in understanding these animals and their environment.

Our present efforts are hampered by the lack of adequate computer equipment for data analysis. Presently we are subsisting with a dual floppy disk drive Leading Edge computer and an old Macintosh system. This is fine for a small database, but as our volume of data grows, so do our computer needs. In addition to database use, we are growing into other applications as well, namely: setting up computer communications between the main office at the UHCL and the office on Galveston Island; using computer mapping programs to track animals' movements within the study area; and computer imaging to enhance and help analyze photographs used to identify individual animals. It recently came to my attention that you cannot keep systems that you review, and frequently donate them to worthy causes. If you have a system that you think would be appropriate for us (either an IBM compatible or a Macintosh), we would appreciate being considered for such a donation.

Chiara DeNeve
University of Houston–Clear Lake
Houston, TX

You would not imagine—or perhaps you would—just how many letters I get requesting equipment. The sad truth is that I don't have surplus equipment: Either the companies that send me stuff want it back, or it's pretty thoroughly used up before it ever leaves here. Cheetah, Priam, and Maximum Storage did make up a system for the Lowell Observatory, but I'm on the board of that institution.

My advice to you and all the others who write me is to ask a local organization; in your case, I'd say Texas Instruments in Austin, Tandy in Fort Worth, or any of the myriad good to excellent small computer companies. I've found that Texans are usually willing to take care of their own!

You can also try Non-Profit Computing, Inc., at 40 Wall St., Suite 2124, New York, NY 10005. Good luck.—Jerry

Perfect Word Processors?

Dear Jerry,

I was so intrigued with your January column that I have decided to subscribe to BYTE in order to follow more closely your quest for a new word processing program. I, too, am looking for a new word processor.

I started out with MultiMate. I had no real complaints, but for a long time the company seemed to take little interest in providing improvements, and I decided that it was about to go the way of the dinosaurs. It turns out that my gloomy prediction was wrong, but by then I had gone on to Microsoft Word. Although I don't pretend to have mastered it, Word seems to be able to do just about everything except wash the dishes. Unfortunately, it also has an extremely irritating gimmick. To issue a command, you must first press the Escape key. This goes against all logic. Most software programs use the Escape key as a whoops-I-made-a-mistake-get-me-out-of-here button, and keyboards put it in an out-of-the-way location so you don't press it accidentally. I thought I would get used to this peculiarity, but I have not. In fact, I find myself trying to do things in Lotus 1-2-3 that are much easier done in a word processor, so it is time to look for something else.

Everyone seems to think that WordPerfect is the ultimate, but I don't agree. Since most offices use the program, it has become a fad. But those things come and go. I remember when MultiMate was the office standard. In any case, I can't get excited about a program whose commands are so arcane that you need a translator like PluPerfect.

In a slightly different vein, I am curious to know if I am the only person in the world who doesn't care about bigger and better spelling checkers and computerized style editors. Most of my work involves large numbers of proper names, so a spelling checker is virtually useless. And a spelling checker can't solve the worst problem of modern newspaper and magazine writers, which is learning the difference between words like *sights* and *sites* or *affect* and *effect*. As for style checkers, I think they are an abomination. There are always a few exceptions, but most articles you read these days on any subject might just as well have been written by a computer. There is so little human personality left after the thing has been "style checked" that you end up with pabulum for the mind.

Since you are in the rather enviable position of being able to do some hands-on exploration of various word processors, I look forward to reading about your reactions.

Elaine Obenchain
Woodstock, IL

Recently, the MultiMate people have started a veritable campaign to get me interested in their word processor, and I finally have a copy, after some years.

Although Escape as a menu and command-introduction key probably is counterintuitive, Write (following Electric Pencil) did it that way, and I was able to write quite a few books with it.

With spelling checkers, good enough is usually good enough; I do like having the ability to add case-sensitive names to my own dictionary, since I tend to make up character names like Chowpeentulk, and creatures like grendels....—Jerry ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."

Hugh Kenner

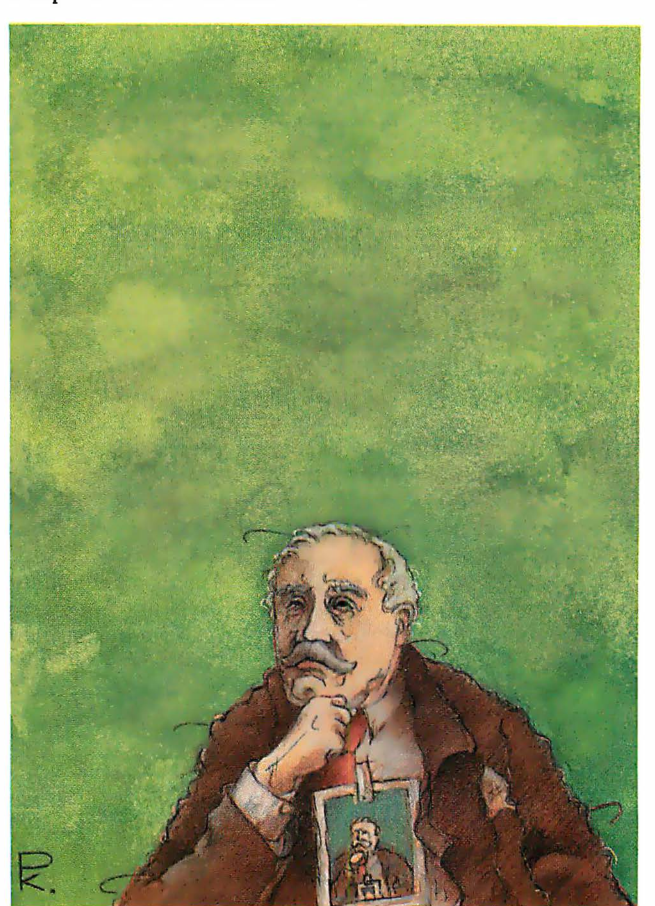
Images Beget Images

Mighty images from tiny blobs —and shoots, and branches—do grow

Let's attempt what the physics mavens call a thought experiment. Here, before your eyes, is a card mottled with blobs of gray, a photo of fat Uncle Felix. And right here, by golly, is fat Uncle Felix himself, by no definition a card of any sort. Yet the eye does detect some match between photo and Uncle Felix.

Next: Here, before your eyes, is a graph (1979–1989) of the Gross National Product, a card scrawled with lines. And right here. . . but wait a minute, where's the GNP we'd hoped to match to the card? No. The GNP, unlike Uncle Felix, is not producible—except as the graph itself, or else as some columns of numbers the graph models, or maybe as some figment the numbers claim to clothe, a fey Salome a-dance in economists' heads.

So we're long used to pictures of things that do not exist the way fat Uncle Felix does. Those are special cases? Not according to *Visualization* by Richard Mark Friedhoff and William Benzon (Harry N. Abrams, 1990, $49.50), which sets out to persuade you of a further proposition: that *nothing*, not even Uncle Felix, exists for your eye the way you thought Uncle Felix did. Your eye and brain *create* an Uncle Felix, whether scanning his bulky presence or his photo. And that's not too remote from the way you accept a visual GNP.



Time was when we thought otherwise. The eye just relaxed as photons streamed toward its retina, where receptors sorted out red, blue, and green for the brain to merge (hence Uncle Felix's salmon-pink necktie). That notion, now more than two centuries old, never did explain why we see things "truly" colored through green sunglasses, or under ruddy late-day light; or why reds next to blues look different from reds next to yellows.

Visualization is dedicated to Dr. Edwin H. Land, and if you accept Land's Retinex model of how vision works (as an astonishing demonstration I saw in 1975 inclines me to do), you'll be prepared to accept that the brain is ever busy at computing visual results from minimal cues. Feed your retina merely *two* colored images, and your brain can show you a whole spectrum. The key word is *images*, not *blobs*. Of images we always try to make sense, in a way that extends to filling in colors and shades. Making sense of the blobs that constitute Uncle Felix's photo, we perceive them as an image and then as a man. And our knowledge of "man" is what enables our skill at perceiving a man-image.

Moreover, "images" can be pretty abstract. On page 26 of *Visualization*, we're shown a rectangle cut into dark-gray and light-gray halves. But lay a pencil over the boundary: Lo, the whole thing becomes medium-gray! Once the frontier where two shades collide is removed, we no longer know that we're meant to see two shades. So we simply don't see them. They become as one.

What all this has to do with a book subtitled *The Second Computer Revolution* is something the authors aren't deft at explaining. Never mind, look at the pictures, some 140 of them in color. They are pictures of things never seen: Things for which either (1) no corresponding Uncle Felix is producible, or (2) some real Uncle Felix never got within camera range.

Example of no Uncle Felix: A picture where reds and blues map magnetic polarities in an iron crystal; that's quite as abstract as the GNP. Example of an inaccessible Uncle Felix: A cinema flyover of a moon of Uranus, which no one has really flown over with a movie camera. It was synthesized from flat *Voyager II* images, "combining image processing, computer graphics, computer stereopsis, and animation."

We're shown four frames, with alarming deep canyons and craters, side views mathematically re-created from the plan-views *Voyager II* re-

ILLUSTRATION: PETER KALABOKIS © 1990

turned across 2 billion miles. Imagine the illusion the projected film produces, of gazing across Miranda from a moving bubble a mere dozen miles up! Imagine, too, from what subtle cues it was reconstructed! Yet how firmly.

Image processing, computer graphics, computer stereopsis, animation: Those are all frighteningly computation-intensive—millions upon millions of instructions per second, weeks of CPU time. And then we merely glance at what they yield. Pictures seem *quick*, till we learn to look at them the way we've learned to look, long, long, at Botticelli's *Venus*, though for other satisfactions. If she's just an undressed lady atop a seashell, our way of looking is skewed. And a fractal "mountain" that has never existed, something synthesized by algorithms out of bytes? If that can seem just another hunk of rock, well, we need educated eyes to look again.

And a synthesized tree? In July 1984, Alvy Ray Smith wrote of graftals in the SIGGRAPH annual, *Computer Graphics*. In July 1986, the magazine *Computer Language* published Turbo Pascal graftals programs that Steve Estvanik and Ken Birdwell had derived from Smith's article (buggy as printed, still they're fun to play with). Graftals was Smith's term for graphics programs that mimic, more or less, the way plants and trees grow, programs that don't start from the final image but build it, so to speak, in the plant's way, from the moment a shoot breaks ground.

That there's a graspable order in the way plants build is a very old intuition. Leonardo da Vinci in the sixteenth century thought that "in each year the total estimated size of the branches...equals the size of the trunk." By "size," he seems to have meant "volume of wood"; thus, when a trunk splits into two boughs, their summed cross-sectional area (assuming proportional lengths) should equal the trunk's.

In the 1840s, the Victorian art critic John Ruskin had a similar idea; artists had to understand how trees grew to draw them right, and equivalent splitting was the way Ruskin said they grew, right down to the tiniest twigs. Though not exact, the Leonardo/Ruskin Law does seem acceptably close for making drawings look right.

In 1917, late in a horrible war, D'Arcy Wentworth Thompson published *On Growth and Form.* He revised it in 1942, when we were immersed in another horrible war. Its 1116 pages seem to say: Whatever may be passing, some things do abide; and whatever abides obeys mathematical laws. Such laws tell us that 300 feet is about the maximum height of a tree, before it bends and falls of its own weight. If its foliage is heavy (as in oak versus pine), that maximum will be less. No matter what the numbers may be, Thompson persuades us over and over that they do exist.

So if we want to set a computer to drawing a tree (or a tumbleweed), we're hemmed in by enough numerical constraints to set any programmer aglow. A plant, moreover, seems to be following a program; it rises from its root, divides; rises some more, divides, even as the earlier divisions are dividing.... But at each division it preserves, so to speak, *meaning*; thus, the branch of an elm doesn't suddenly resemble a cactus. The scenario has been likened to the one Noam Chomsky offered, decades ago, for language: Concise rules that change simple sentences into complex ones without loss of essential content. Concise rules, likewise, for a plant?

Maybe. But plants grow by parallel computation—analogous things all happening at once—which does complicate matters. *The Algorithmic Beauty of Plants* by Przemyslaw Prusinkiewicz and Aristid Lindenmayer (Springer-Verlag, 1990, $39.95) summarizes what seems to be known of the algorithms, has sumptuous photos of computer-generated images (the color plates include unbelievably lifelike roses), and unhappily reads like a set of SIGGRAPH papers stunned and laid end to end.

After 1968, the late Dr. Lindenmayer, known for his L-System, was the doyen of this field; the bibliography lists no fewer than 11 of his papers. His death shifted the compiling of a text to Prusinkiewicz and four collaborators. They've been rigorous to (I'd almost say) the point of unreadability. Actually, they are transparently readable for their intended audience: workers who need firm theory to underpin envisaged graphics programs. The rest of us can skim, and can gaze at the marvelous pictures.

And we can note how Benoit Mandelbrot's fractal self-similarities turn up on the first page. Yes, plants are self-similar; a young shoot's favoring of the south side can continue, out to the furthest branches. Yet (following a hint in the bibliography) we can learn, from Norman MacDonald's *Trees and Networks*, that "self-similar" may be a theme to use with caution. Lung airways, tree branchings, paradigms of self-similarity, resemble one another, yes. But not exactly, because trees must sustain their own weight and lungs need not. That's the sort of thing Thompson insisted on: There are always physical constraints.

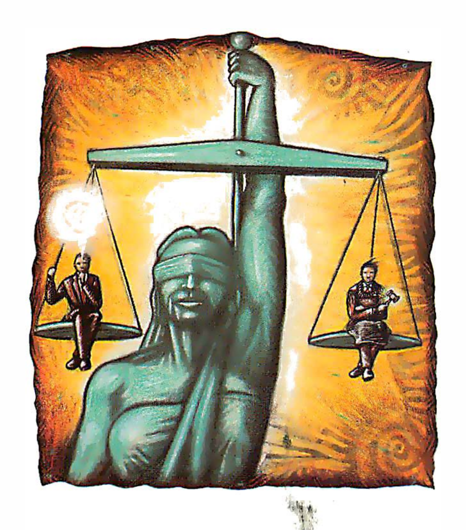
The gist of *The Algorithmic Beauty of Plants* is that "production rules" are feasible and fruitful; rules that derive a complex configuration from a simple one by systematic replacement of terms. Thus, two rules: (1) replace *a* by *ab*; (2) replace *b* by *a*—allow us to start with *b* and obtain, successively, *a*, *ab*, *aba*, *abaab*, *abaababa*, *abaababaabaab*...where you can see a wild symmetry (note how *a*'s tend to pair). Let *a* and *b* denote laws by which twigs branch, and you see a tree taking more and more intricate shape.

You see, too, how self-similarity comes in; hence, why trees (as Mandelbrot insists) are fractal. Still, remember the physical! And devise some more rules.

Addendum: After my review of books on fractals (June) was finished, the mail brought a program called Mandelbrot 3 (Midnight Beach, 1805A Felt St., Santa Cruz, CA 95062, (408) 479-9916) for the IBM PC and clones. Unlike the FractInt I discussed, it handles only the basic Mandelbrot and Julia sets. But it handles them *very* fast and with superexcellent graphics. Be sure to get version 2.03, which won't lock up in the absence of a mouse. (You *have* a mouse? Well, even mice are mortal.) ■

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times *and* Harper's. *His recent books include* A Sinking Island *and* Mazes. *He can be contacted on BIX as "hkenner."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



LITIGATION VS. INNOVATION

Let's strike a balance between protecting intellectual rights and encouraging innovation

The personal computer revolution was catalyzed by young rebels, dropouts, and visionaries who helped forge what has become a multibillion-dollar industry of global import. These people fundamentally changed how computers were used and how business—and government—got work done, by making computers useful and accessible to millions of ordinary citizens without special computer expertise. I like to think that the company I founded, Lotus Development, played an important role in that.

As a software entrepreneur, my perspective on intellectual property isn't grounded in theory or law—it's based on my experiences trying to turn innovative ideas into real businesses.

Let me make a bias clear up front: I like new ideas. I like being part of a creative community of software designers, each trying to surpass the others. I like having the market tell us which innovations are exciting and which aren't. I like the fact that copying and distributing pirate versions of our software is a punishable crime.

Let me tell you what I don't like. I don't like companies acting as if they have a monopoly on a good idea. I don't like companies forgetting that, like it or not, they also learn from their competitors and their competitors' customers.

Pamela Samuelson, an intellectual-property scholar at Emory University in Atlanta, describes intellectual-property advocates as ranging along a scale from minimalists, who believe in the bare essentials of protection, to maximalists, who insist that intellectual property is so precious that it must be surrounded by a phalanx of razor-edged laws.

I am a minimalist. That doesn't mean I don't care about intellectual-property protection; it means that I don't want protection to become the dominant theme, or even *a* dominant theme, of this industry. If you want to keep this industry as vibrant and successful as it's been, then a properly constructed intellectual-property policy will respect protection but give preference to innovation. Overprotection of intellectual property is as pernicious as underprotection in its stifling effects on innovation and the consequent loss to society.

Unfortunately, the computer industry is experiencing an unsteady but stubborn march to extend the scope of copyright. Twisting and straining each step of the way to secure additional copyright protections, too many companies seem to have decided that it's easier to sue their rivals than compete with them. Litigation is becoming a business tactic, not a practice of last resort. Software should not be an industry driven by litigation. That would be bad for both the industry and its millions of customers.

It would be great if we could just draw a line and, say, outlaw software clones of specific application programs. But I'm concerned about where the line ultimately gets drawn. The next foreseeable step, in which litigants seek to protect individual features and elements of programs, per se, under copyright, would be one step too far.

Speaking from my own observation, the so-called spreadsheet clones have achieved but the tiniest of market shares, and I don't believe that's an accident. Cloning applications is an unviable business strategy. Success in the software business depends on many factors: documentation, training, customer support, and the quality of customer relations in general. All these factors favor the large, well-financed software companies.

Software is complex and idiosyncratic; unless someone is deliberately copying the internals of the code, reproducing a sophisticated application with quality and utility equivalent to the original is difficult and expensive. Any firm with the resources to do a good job at this prefers to create original products that represent a greater opportunity.

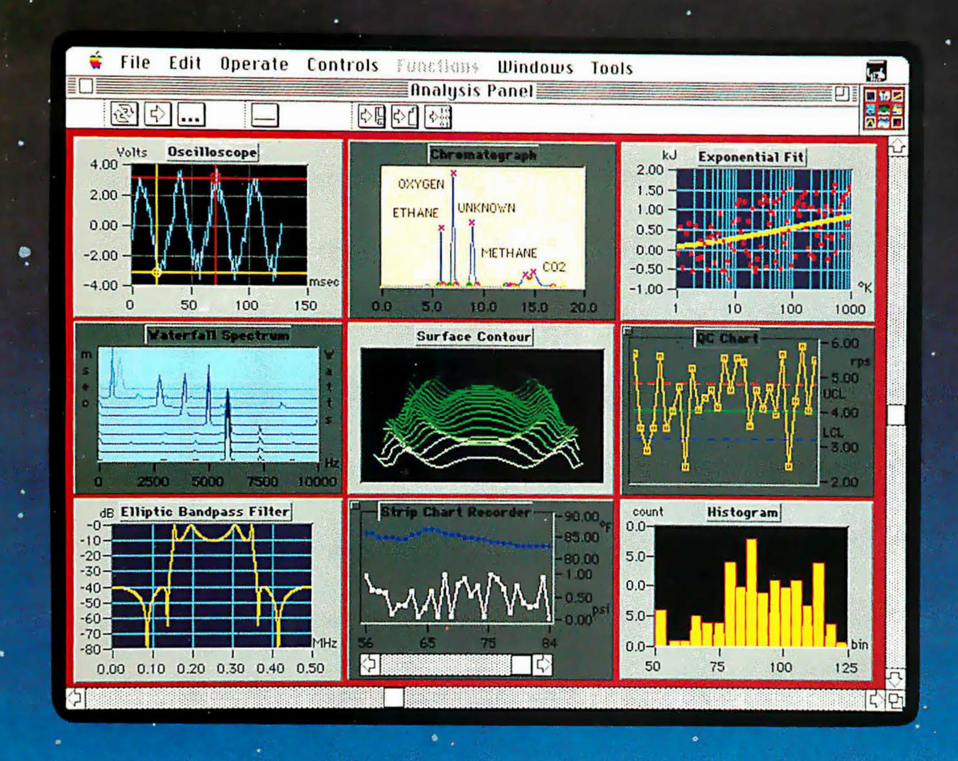
It's the nature of software for ideas to slosh and flow back and forth between competitors, companies, and industries. Like architecture and the movies, software is a medium for ideas.

Some firms would like to have their works fully protected but be free to benefit from the efforts of others without much regard for intellectual-property rights. They must be reminded that the law has an obligation to be evenhanded.

Of course, complicating all this is that software is a different kind of intellectual-property beast. Professor Samuelson observes that software is both a writing and a machine—in a legal system that has assumed something can be either a writing or a machine, but not both.

Increasingly, the economic value that we add to this society and the global economy is this intangible, crystallized mindstuff called software. America's software industry happens to be the best in the world, and that isn't due to intellectual-property lawsuits. The challenge is, what regime is going to continue to support our ability to do well? If our policy comes out of court battles, then we're going to have an industry that looks as though it were shaped by lawyers and judges, not by technically innovative and market-sensitive entrepreneurs. ■

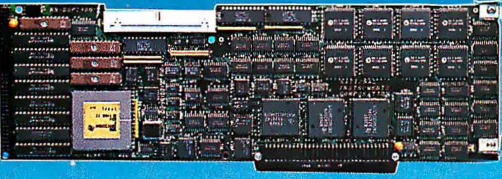
Mitch Kapor, founder of Lotus Development Corp. and co-creator of Lotus 1-2-3, is president of On Technology. This column is adapted from testimony offered to the congressional committee on intellectual-property rights, to which he made the opening remark, "Software has been very, very good to me." He can be reached on BIX c/o "editors."



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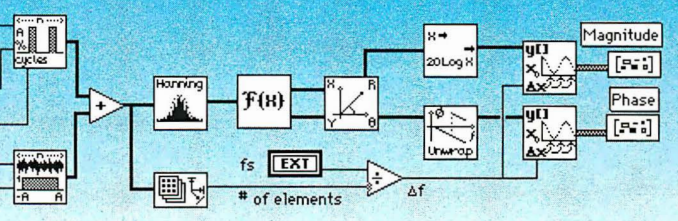
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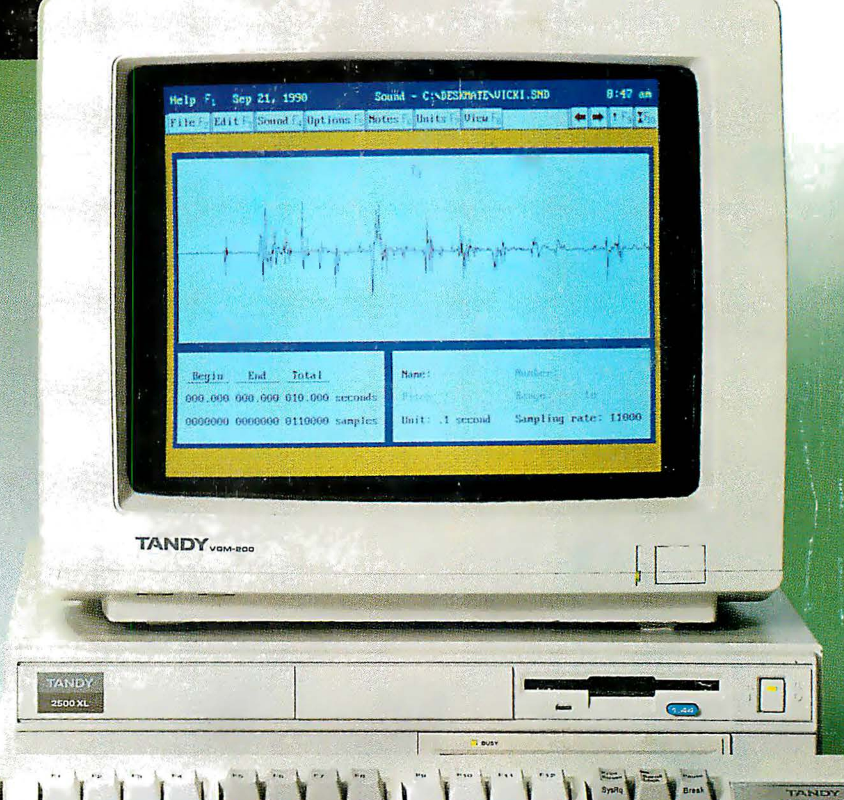
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